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Collaborating Societies:

**SEPEX**  
Sociedad Española de Psicología Experimental

## ABSTRACT BOOK

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Symposia







ANDALUCIA III ROOM,  
THURSDAY 5TH MAY 2016, 15:20-17:20  
**SY01 Implicit Learning: Research  
Methods for the Next Decade**

**Dissociating Implicit and Explicit Processes of Evaluative Learning: Current State and Future Directions.**

MANDY HÜTTER, *Eberhard Karls Universität Tübingen*.

Changing evaluations of stimuli by pairing them with affectively laden stimuli is called evaluative conditioning. A central question in this field is whether such pairings can change evaluations via processes that operate efficiently, in the absence of awareness, are uncontrollable, and/or not influenced by intention. I present a line of research, in which multinomial processing tree models are utilized to distinguish between aware and unaware and controllable and uncontrollable learning processes, respectively. The results support dual-process models of evaluative learning with the relative weight of the two types of processes being moderated by characteristics of the learning situation. I will discuss the risks and opportunities of such a process dissociation method as well as alternative experimental approaches.

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**Knowing When to Say No: The Importance of Using Bayes Factors.**

ZOLTAN DIENES, *University of Sussex*.

Many papers in many disciplines use non-significance as a criterion for asserting the null hypothesis. I illustrate the problem with research seeking to demonstrate or refute unconscious processes, such as implicit learning or subliminal perception. Typically, concluding knowledge is unconscious relies on asserting the null hypothesis of chance explicit recognition, or chance level of meta-cognition. Non-significance has been the near universally used criterion for asserting the null. We all know that this is entirely invalid; fortunately now we have the tools to do considerably better. These Bayesian tools allow previous conclusions to be re-evaluated, as will be demonstrated. The denial of unconscious knowledge also often rests on asserting the null hypothesis of no priming under certain conditions based only on non-significance. We all know that this is entirely invalid. Thus, such claims can also be re-evaluated. I will show how both objective and subjective measures can be implemented to explore unconscious processes while escaping the inferential pitfalls of significance testing. The general approach, while illustrated with research on implicit processes, is applicable to all research that uses inferential statistics.

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**The Insignificance of Awareness Tests in Implicit Learning Experiments.**

MIGUEL A. VADILLO, *King's College London*, EMMANOUIL KONSTANTINIDIS, *Carnegie Mellon University*, DAVID R. SHANKS, *University College London*.

The ambiguous status of null results is possibly one of the most important shortcomings of Null Hypothesis Significance Testing (NHST). In NHST, a null hypothesis can be rejected, but it can never be proved. Yet, experimental psychologists rely routinely on

null results to claim that a specific effect is absent. For instance, learning is considered implicit or unconscious if participants are unable to perform above chance in a task designed to measure their awareness, but the absence of awareness cannot be assessed using NHST. Participants' failure to perform significantly above chance could be due to a simple lack of statistical power or to the use of unreliable tests. We review evidence supporting the claim that a popular implicit learning effect, contextual cueing, takes place in the absence of awareness. A systematic literature review shows that the null results used to claim that this type of learning is implicit are likely to be false negatives. Even if one takes into account only non-significant results, which presumably provide the best evidence for the lack of awareness, the meta-analytic performance of participants in awareness tests is significantly above chance. Similarly, researchers typically conclude that learning is unconscious when there is no correlation between participants' performance and their awareness. Our results suggest that, at least in the case of contextual cueing, the lack of correlation between learning and awareness is based on weak evidence and on a faulty use of NHST. Bayes factors provide useful hints about how future research could obtain stronger evidence.

**Three Ways to Fool Consciousness's Radar, and Methodological Implications Thereof.**

AXEL CLEEREMANS, *Université Libre de Bruxelles*.

A great conceptual pendulum oscillates, with a period of about 30 or 40 years, over our understanding of the relationships between conscious and unconscious information processing. Its path delineates the contours of the unconscious mind as well as its contents: Sometimes smart and defining the very fabric of the mind, the unconscious is at other times relegated to taking care of little more than our bodily functions. At this point in time, the pendulum finds itself hovering rather steadily on the side of those who think so many functions are served by the unconscious that they even question the very role that consciousness plays in shaping the human mind. Here I will suggest that the pendulum has swung a little too far, and illustrate the argument with recent experimental findings that document how challenging it may be to arrive at a satisfactory conception of the relationships between conscious and unconscious information processing. I focus on three different ways through which one can attempt to make knowledge unconscious: (1) weakening the stimulus, (2) diverting attention, and (3) changing the narrative. Each experimental strategy has its own methods, applies to different paradigms, and each has its own pitfalls and benefits. A few general principles emerge from this cautiously skeptical analysis. First, awareness cannot simply be "turned off". Second, the reach of the unconscious is probably overrated. Third, there is a pervasive and continuing confusion between information processing without awareness and information processing without attention. I suggest that considering how learning and plasticity mechanisms modify conscious contents can reduce this confusion.

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**Regressive Research: The Pitfalls of Post Hoc Data Selection in the Study of Unconscious Mental Processes.**

DAVID SHANKS, *University College London*.

Many studies of unconscious processing involve comparing a performance measure (e.g., some assessment of perception, memory, etc.) with an awareness measure (such as a verbal

report or a forced-choice response) taken either concurrently or separately. Unconscious processing is inferred when above-chance performance is combined with null awareness. Often, however, aggregate awareness is better than chance, and data analysis therefore employs a form of extreme group analysis focusing post hoc on participants, trials, or items where awareness is absent or at chance. The pitfalls of this analytic approach are described with particular reference to recent research on implicit learning and subliminal perception. Because of regression to the mean, the approach can mislead researchers into erroneous conclusions concerning unconscious influences on behaviour.

MACHUCA ROOM,  
THURSDAY 5TH MAY, 15:20-17:20

## SY02 The Role of Task Representation in Response Selection

### The Effect of Task Structure on Cross-Stimulus Control.

ERIC H. SCHUMACHER, SAVANNAH L. COOKSON, *Georgia Institute of Technology*; ELIOT HAZELTINE, *University of Iowa*.

The mechanisms for response selection are uncertain. It is controversial whether it involves more than simply linking stimulus and response representations. This presentation will review evidence across a variety of experimental procedures (e.g., congruency sequence effects, CSE, and partial task precuing) suggesting that the participants' representation of the task affects the duration of response selection. For example, using a version of a flanker task, we show that CSEs (also known as conflict adaptation and the Gratton effect) depend on the structure of the task (i.e., CSEs did not cross stimulus or response boundaries when those boundaries were task relevant; Hazeltine et al., 2011). Similarly, using a partial precuing procedure, we show that participants benefit from a partial task cue, only when the cue indicates one task or the other – and not when the cue indicates specific stimulus-response pairs. Finally, brain activation evidence is consistent with these behavioral effects. Together, these results indicate that control processes for response selection are affected by the structure and boundaries of the task representation.

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### Exploring Stimulus-Response Associations Formed by Instruction.

ANDREA KIESEL, CHRISTINA PFEUFFER, *University of Freiburg*; KAROLINA MOUTSOPOULOU, FLORIAN WASZAK, *Université Paris Descartes/CNRS (Laboratoire Psychologie de la Perception, UMR 8158)*.

Previous studies on item-specific priming provided evidence for two distinct components of acquired stimulus-response associations: Stimulus-Action (S-A) and Stimulus-Classification (S-C) associations. In a current set of experiments, we merely instructed S-A and S-C associations for a specific target-item in a prime trial and assessed their impact on responding in a probe trial in which primed S-A and S-C associations either repeated or switched. Response times increased for both S-A and S-C switches compared to repetitions, indicating that mere instruction induces associative learning and influences later behavior. Thus, item-

specific S-A and S-C associations are formed by mere instruction and they are automatically retrieved even when these instructions are not goal-relevant.

In a number of experiments, we elaborated on the functional (dis) similarity of S-A and S-C associations that are either acquired by application or formed by mere instruction. S-A and S-C associations usually impact on behavior independently, stressing the automatic, “dump” character of their retrieval. Nevertheless, both types of associations are rather stable in time. Interestingly, instructed associations depend on working memory capacity while associations acquired by application are independent of working memory load. Thus, our findings provide evidence for functional differences between associations formed by mere instruction and by application.

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### How Task Representations Guide Attention: The Shielding Function of Task Rules.

GESINE DREISBACH, *University of Regensburg*.

Cognitive control enables humans to flexibly switch between different thoughts and actions. An important prerequisite for this cognitive flexibility is the human ability to form and apply general task rules. In my talk, I will present research investigating the functional role of task rules (as compared to stimulus-response rules), with an emphasis on two main findings: First, the shielding function of task rules helps guide attention toward task-related information, thereby reducing possible distraction by irrelevant information. Second, this task shielding has to be relaxed when a task rule changes, hereby making the cognitive system more vulnerable to the intrusion of distracting information. Possible costs and benefits of the shielding function of task rules will be discussed.

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### Cortico-Striatal Interactions and the Representation of Hierarchical Task Structure.

DAVID BADRE, CAROLYN RANTI, CHRISTOPHER CHATHAM, and APOORVA BHANDARI, *Brown University*.

Many tasks in the real world are structured hierarchically in that they require us to control immediate actions while also holding more abstract, temporally remote goals in mind. But, it is unclear how people represent such tasks in order to control their behavior. Cognitive control is also widely viewed as a hierarchical process because higher order contexts and decisions influence selection of lower order responses. Yet, this type of contextually-guided action selection is often addressed in the context of relatively simple stimulus-to-response (S-R) rules. In these simple cases, early perceptual stages are thought to lead to an S-R mapping stage that maps the percept to a response, and this in turn leads to a terminal response stage. However, it has not been clear how multiple higher-order contingencies, such as are required by a hierarchical task structure, are accommodated in this single channel model. In this talk, I will describe a line of work directly investigating the cognitive and neural bases of complex hierarchical control. First, I will provide behavioral evidence that multiple, hierarchically ordered S-R contingencies can be processed in parallel during a central S-R stage. Then, I will describe a model and its associated neural and behavioral evidence wherein these dynamics emerge from cortico-striatal “gating” interactions. Finally, I will provide evidence that these gating interactions have dynamics that people



build directly into their representation of a task, along with more traditional S-R rule contingencies.

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### High-Dimensionality Neural Responses for Learning and Implementation of Context-Dependent Task Rules.

MATTIA RIGOTTI, *IBM T.J. Watson Research Center.*

Single-neuron activity in frontal cortex is characterized by striking complexity: in animals engaged in cognitive behavior, responses are reliably but idiosyncratically tuned to mixtures of multiple task-related aspects. We will see that such “mixed selectivity” at the level of individual cells is a signature of high-dimensionality at the level of the population activity. We will consider theoretical models suggesting that such high-dimensionality confers impressive computational advantages to a neural circuit in terms of 1) the richness of the set of implementable downstream responses, and 2) the capability of flexibly learning new association rules. Finally, we will examine empirical electrophysiological and behavioral evidence supporting the predictions of these models during working memory and context-dependent conditioning tasks.

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### How Task Representations Guide Central Operations.

ELIOT HAZELTINE, *University of Iowa*, ERIC H. SCHUMACHER, *Georgia Institute of Technology.*

Experimental psychologists often describe task sets as collections of stimulus-response (S-R) associations that allow sensory information to activate motor codes in a feedforward fashion. However, findings from a range of studies indicate that this conceptualization is inadequate in that it fails to provide an explanation for many aspects of behavior relating to the importance of intentionality and the context in which an action is performed. In particular, it is apparent that response selection involves task representations that include information about relationships among S-R mappings such that the content of one individual S-R mapping affects how others are performed. This phenomenon has been well-established for many years in topics such as S-R compatibility and congruency. I will explore how it is manifest in incidental learning, the Hick-Hyman law, and bimanual coordination. In incidental learning tasks, relationships among the intentions associated with actions, not relationships among the physical properties of the stimuli and responses, determined whether learning took place. In studies of the Hick-Hyman law, the effects on response time of adding S-R alternatives to the task set depends on the relationships of these alternatives to others in the set. In experiments probing the sources of bimanual crosstalk, the online interference associated with producing two responses at the same time is not just conceptual but that the concepts themselves are determined by the organization of the task. Taken together, these findings suggest that the information guiding central processes is both conceptual and structured, as befits the intricacies of voluntary action.

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## FALLA ROOM, FRIDAY 6TH MAY, 8:20-10:00 SY03 Stress Assignment in Language Processing

### Does a Canonical Stress Pattern Facilitate Word-Learning?

ROBERT DALAND, *University of California.*

Some phonotactic generalizations are projected from the lexicon. But once the phonotactic grammar is established, does it in turn affect lexical acquisition? To address this question, we conducted a word-learning study with American English speakers. Stress in English is lexically contrastive, but bisyllables are predominantly trochaic. Does this generalization play into word-learning, e.g. rendering novel trochees easier to learn than novel iambs? Participants were exposed to 20 novel word forms, paired with 20 alien pictures designed for word-learning studies; half were exposed to novel trochees, while half were exposed to novel iambs (e.g. [ˈfomək]~[fəˈmɜk]). They completed two form-level tasks (nonword recall, nonword repetition) and two form-meaning association tasks (picture identification, picture naming). In nonword recall, participants were tested on 20 exposure word forms and 20 stress-matched foils, and were asked to indicate whether they had heard the form before. There was no significant difference in accuracy between trochaic and iambic participants. In picture identification, participants heard an exposure form and saw four alien pictures; they were asked to pick the picture corresponding to the alien they saw in the exposure phase. Trochaic subjects were about 25% more accurate than iambic subjects, a significant difference. The results suggest that there is a learnability benefit for words that have a canonical/preferred phonotactic pattern.

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### Megastudy of Sublexical Cues to Stress Assignment in English: Behavioural and Computational Data.

BETTY MOUSIKOU, KATHLEEN RASTLE, *Royal Holloway, University of London.*

People assign stress to nonwords in a relatively consistent manner (Rastle & Coltheart, 2000), suggesting that the sub-word knowledge used in reading aloud extends to stress assignment. Further, though most English words take first-syllable stress, there are instances where people routinely assign second-syllable stress to nonwords, ruling out a simple ‘default’ rule for stress assignment. Several sub-word cues to stress assignment have been proposed, including vowel length (i.e. long vowels take stress), phonological and orthographic weight (i.e. syllables with more phonemes and more letters draw stress), and morphological structure (i.e. affixes repel stress). However, these cues have often been confounded in the literature. In the present study, we studied systematically the cues to stress assignment in English by examining stress placement in 915 disyllabic nonwords that were read aloud by 41 skilled adult readers. Our results show that second-syllable stress becomes more likely when (a) the onsets and rimes of both syllables are consistently associated with second-syllable stress; (b) orthographic weight is biased toward the second syllable; (c) there is a long vowel in the second syllable; and (d) the nonword has one or more orthographic neighbours with second-syllable stress. However, affixation per se does not seem to influence stress placement. Participants’ stress



placements were compared to the performance of rule-based (DRC; Rastle & Coltheart, 2000) and probabilistic (CDP++; Perry et al., 2010; Seva et al., 2009) computational models of reading aloud. The results from this comparison favour a probabilistic approach to stress assignment.

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### Sublexical Cues to Stress Assignment in English Disyllabic Words.

MARIA KTORI, BETTY MOUSIKOU, KATHLEEN RASTLE, *Royal Holloway, University of London.*

Several proposals have been put forward regarding the sublexical cues that readers use for stress assignment when reading aloud English disyllabic words. These include the morphological structure of a word (i.e., prefixes repel stress; Rastle & Coltheart, 2000), vowel length, (i.e., long vowels attract stress; Guion et al., 2003), and orthographic weight (i.e., more letters attract stress; Kelly et al., 1998). However, these cues have been often confounded and not studied in a systematic manner. In a series of experiments, we tested the influence of prefixation in combination with the other sublexical cues by asking participants to read aloud carefully constructed disyllabic nonwords. In Experiment 1, nonwords varied on the inclusion of a prefix and the length of the second vowel (e.g., predus and predous vs. pradus and pradous). In Experiment 2, nonwords varied on the inclusion of a prefix and the number of letters in the second syllable (predus and preduss vs. pradus and praduss). Results revealed main effects of prefixation, vowel length, and orthographic weight on the assignment of second syllable stress, and no significant interactions. In Experiment 3, we re-examined the effect of prefixation and vowel length while accounting for the orthographic weight of the second syllable (e.g., preduss and predous vs. praduss and pradous). Preliminary results show that the main effect of vowel length persists independently of the number of letters in the second syllable. These findings suggest that readers are sensitive to and utilise several sources of sublexical information to assign stress in reading aloud.

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### Stress Effects on Articulatory Planning in Reading Aloud.

SIMONE SULPIZIO, *University of Trento, Fondazione Marica de Vincenzi ONLUS*, CRISTINA BURANI, *Institute of Cognitive Sciences and Technologies, CNR, University of Trieste.*

Stress assignment is a core step in reading aloud of any polysyllabic language as Italian: To correctly articulate a printed stimulus, readers have not only to activate the correct phonological segments, but also assign stress to one of the syllables, since this has to be articulated as (acoustically) more prominent. Being this the case, does stress assignment affect stimulus articulation? In the present paper, we try to answer the above question by reporting the results of 5 pseudoword reading experiments run in Italian. Italian is a free-stress language with two main stress patterns, i.e., penultimate stress (dominant pattern, occurring on the penultimate syllable of the word, e.g., maTIta 'pencil') and antepenultimate stress (non-dominant pattern, occurring on the antepenultimate syllable of the word, e.g., BIbita 'drink'). Across experiments, the effect of stress assignment on articulatory planning was investigated by varying stimulus stress (antepenultimate vs. penultimate), stimulus length (three- vs. four-syllable pseudowords), and reading procedure (immediate vs. delayed reading aloud). Results show

that, irrespective of stimulus length, Italians are faster in reading pseudowords when assigning them antepenultimate than penultimate stress. Moreover, and more important, such stress effect survives the delayed procedure, suggesting that stress assignment may affect reading up to articulatory planning, that is when the phonological codes are converted into articulatory programs. The stress effect also suggests that, in reading aloud, the minimal planning unit for articulation is smaller than the whole stimulus, including the first syllable up to the stressed unit.

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### Stress Assignment in Speech Production.

NIELS O. SCHILLER, *Leiden University.*

Linguistic theory predicts that stress is computed on the basis of complex rules, which can sometimes interact in complex ways. In contrast, psycholinguistic theories generally assume that at least irregular stress is stored in the lexicon. The representation of regular stress is less clear. Behavioral experiments have found little evidence for the storage of lexical stress. For instance, Dutch speakers did not show a stress congruency effect in a number of picture-word interference studies. However, there is evidence that Dutch speakers treat words with initial and final stress differently, both behaviorally and electro-physiologically. More specifically, results from a production monitoring study indicated that Dutch participants could make a lexical stress decision significantly earlier when picture names had initial than when they had final stress. Moreover, these data suggest a time course of lexical stress encoding during single word form formation in language production. When word length is corrected for, the temporal interval for lexical stress encoding specified by the ERP results falls into the time window previously identified for phonological encoding in language production.

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## ANDALUCIA III ROOM, FRIDAY 6TH MAY, 8:00-10:00 SY04 Integrating Decision Models and Cognitive Control: Theoretical Implications and Clinical Applications

### Determinism vs. Stochasticity in Action Selection.

ALINE BOMPAS, JÉRÉMIE MATTOUT, *Lyon Neuroscience Research Center, INSERM.*

Objectives. The time taken to initiate even the most basic response to highly salient stimuli varies greatly across trials and, even in the simplest task, participants always make errors. Intra-individual variability in RT is a key aspect in the conceptualisation of sensorimotor decisions. To help constrain computational models (Bompas & Sumner, J. Neuroscience 2011) and understand the neural correlates of spontaneous variance (Bompas et al. NeuroImage 2015), we aimed at characterising variance in behaviour at short, medium and long time scales.

Methods. We asked 30 participants to quickly respond to a peripheral target appearing either left or right, every 3 seconds continuously (without breaks) for 90 min. Targets were preceded by a random cue indicating whether the required response was an eye-movement, a button press or both actions together.



Results. Our analyses provide quantitative answers to the following questions: i) how much variance is spontaneous versus related to the experimental design (factors, trial history etc.); ii) what is the structure of the RT series, for instance how much variance is captured by slow trends such as fatigue or practice or by high frequency noise unfolding within the time course of one single trial (stochasticity); iii) to what extent variability is modality-specific or coupled across modalities – eye movements or manual button presses.

Conclusions. Our analyses suggest that only a small part of the overall variance can be accounted for by deterministic factors, and most of the variance unfolds at the very short time scale. Furthermore, a small but clear part of the variance appears to be shared across modalities, consistent with the assumption of modality-specific decision modules.

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### Striatum Codes for the Dynamics of Decision Urgency in the Human Brain.

BIRTE U. FORSTMANN, LAURE FONTANESI, GUY E. HAWKINS, LEENDERT VAN MAANEN, *University of Amsterdam*.

Objectives. Deciding between multiple courses of action often entails an increasing need to do something as time passes - a sense of urgency. This notion of urgency is not incorporated in standard theories of speeded decision-making that assume information is accumulated until a critical fixed threshold is reached, controlled through activation of the striatum.

Methods. In two experiments, we investigated the behavioral and neural evidence for an “urgency signal” in humans.

Results. Experiment 1 found that as the duration of the decision-making process increased, participants made a choice based on less evidence for the selected option. Experiment 2 replicated this finding, and additionally found that variability in this effect across participants covaried with activation in striatum.

Conclusions. We conclude that striatum plays a more general role in the decision-making process than previously reported. By dynamically updating the threshold, striatal activation represents a neural implementation of the urgency signal in humans.

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### Decision Making in Autism Spectrum Disorders Re-Evaluated Through Diffusion Models.

GEORGIE POWELL, CATHERINE R.G. JONES, *Cardiff University*, GILLIAN BAIRD, *Guy's and Thomas' NHS Trust*, ANDREW PICKELS, EMILY SIMONOFF, FRANCESCA HAPPE, TONY CHARMAN, *King's College London*, PETROC SUMNER, *Cardiff University*.

Objectives. Comparisons of decision-making in clinical populations and healthy controls commonly only find or report differences in one response measure - often response time (RT) or accuracy. Processes are inferred from these measures, for example faster RTs indicate more efficient processing, but the exact mechanisms are unspecified and the relationship between different response measures is unclear. Computational models allow us to combine RT and accuracy measures to isolate cognitively meaningful parameters that influence decisions. Surprising effects can be revealed through this method that would not have been observed in the raw response measures alone, e.g. individuals with AD/HD processes information

more slowly than healthy controls but are just as cautious when responding (Karalunas et al., 2014).

Methods. Using secondary data from the Special Needs and Autism Project (SNAP), we explored differences in decision-making during a face recognition task across 94 adolescents with ASD and 54 typically developing (TD) children.

Results. Raw response time data indicated that the ASD group were faster across all task conditions than TD children, but the drift-diffusion model revealed that this was due to lower caution when responding rather than faster information processing.

Conclusions. Ambiguous differences in response measures (RT/accuracy) were explained using the application of a theory-based model of decision making. In the future, we aim to explore the stability of decision making parameters in ASD across different cognitive tasks.

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### How Response Time Distributions Inform Impulsivity in Neurodegenerative Diseases.

JIAXIANG ZHANG, JAMES B. ROWE, *Cambridge*.

Objectives. Impulsive behaviour is common in many neurodegenerative diseases. It manifests as delay intolerance, risk seeking and failure of inhibition that affect patients' quality of life. The search for symptomatic and disease-modifying therapies for neurodegenerative diseases urgently requires a mechanistic understanding of impulsivity. Here we show that computational modelling of response time (RT) distribution are sensitive for providing mechanistic interpretation of impulsivity in neurodegeneration.

Methods. We investigated impairments of response inhibition in a saccadic Go/No-Go task in 19 patients with Progressive Supranuclear Palsy (PSP) and 24 patients with Parkinson's disease (PD). The two diseases have different neuropathology, but both affect cognitive function including impulsivity. We fitted a drift diffusion model to the RT distributions by using Bayesian parameter estimation approach.

Results. Compared with PD patients and healthy controls, PSP patients had a strongly bias towards a pro-saccade decision boundary and yet were severely impaired at accumulating the necessary evidence to commit to that response. Furthermore, in a leave-one-out three-way classification, the model parameters provided better discrimination between patients and controls than raw behavioural measures.

Conclusions. This combination provides a parsimonious explanation for the apparently paradoxical combination of impulsivity and akinesia seen in PSP.

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### Plasticity in Action Control Can Be Induced by Low Doses of Ketamine.

PIERRE POUGET, *Institute of Brain and Spinal Cord (ICM), CNRS, Paris*.

Objectives. Ketamine, an NMDA antagonist is used since many years by neurophysiologists and veterinarians. Sub-anesthetic doses of ketamine are known to produce a decrease of activity in the frontal lobe and are used to mimic some symptoms of schizophrenia. Recently, two studies have reported that the use of very small doses of ketamine could also be used to improve performance in decision process tasks (Shen et al., 2010; Ameqrane et al. 2015). However



the contributions of the perceptual and/or the motor processes of the effect of ketamine was not possible to disentangle in these pioneer studies.

**Methods.** We design a new switching oculomotor task in order to evaluate the possible sensory and/or motor beneficial effects of very low dose of ketamine injected in two behaving non-human primates.

**Results.** Our results show that only sequence of trials that require the most motor control were improved by very low dose of ketamine, while sensory discrimination processes remain unchanged.

**Conclusions.** In future, we will explore the stability of decision-making parameters under ketamine across different cognitive tasks.

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### Factoring Out Non-Decision Time in Choice RT.

STIJN VERDONCK, FRANCIS TUERLINCKX, *University of Leuven*.

**Objectives.** Choice RT experiments are an invaluable tool in psychology and neuroscience. A common assumption is that the total choice response time is the sum of a decision and a non-decision part (time spent on perceptual and motor processes). While the decision part is typically modeled very carefully (commonly with diffusion models), a simple and ad hoc distribution (mostly uniform) is assumed for the non-decision component. Nevertheless, it has been shown that the misspecification of the non-decision time can severely distort the decision model parameter estimates.

**Methods.** In this paper, we propose an alternative approach to the estimation of choice RT models that elegantly bypasses the specification of the non-decision time distribution by means of an unconventional convolution of data and decision model distributions (hence called the D\*M approach).

**Results.** Once the decision model parameters have been estimated, it is possible to compute a non-parametric estimate of the non-decision time distribution. The technique is tested on simulated data, and is shown to systematically remove traditional estimation bias related to misspecified non-decision time, even for a relatively small number of observations.

**Conclusions.** The shape of the actual underlying non-decision time distribution can also be recovered. Next, the D\*M approach is applied to a selection of existing diffusion model application papers. For all of these studies, substantial quantitative differences with the original analyses are found. For one study, these differences radically alter its final conclusions, underlining the importance of our approach. Additionally, we find that strongly right skewed non-decision time distributions are not at all uncommon.

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## PICASSO ROOM, FRIDAY 6TH MAY, 8:00-10:00 SY05 Relationship between Selective Attention and Working Memory: New Insights from Event-Related Eeg Lateralizations

### Attention's Gas Pedal.

ROBERT M.G. REINHART, GORDON D. LOGAN, GEOFFREY F. WOODMAN, *Vanderbilt University*.

Theories of attention propose that target representations are stored in working memory to bias attention mechanisms to find critical targets in cluttered scenes. However, theories of learning and automaticity suggest that working memory should only serve this purpose early in practice. Using electrophysiological methods and modeling, we first show that on trials in which a large reward could be obtained, people use both working memory and long-term memories to increase the rate of attentional selection on that trial. Perhaps this use of multiple memory representations is a general mechanism used by the brain to increase the rate of attentional selection (i.e., the attentional gas pedal)? If this is a general mechanism, then we should see a similar pattern of electrophysiological activity indicating the use of both types of memory representations when subjects are required to select task-relevant information quickly, but not with reward on the line. We tested this by simply cuing people to perform a visual search task quickly as possible on a subset of trials. These infrequent *go-fast trials* were randomly interleaved with trials using the standard instructions of cognitive psychology to be both fast and accurate. We found that prior to a go-fast trial people could largely rely on long-term memory to perform the visual search task. However, on the go-fast trial people brought working memory back online to supplement the attention control provided by long-term memory. These findings suggest that the use of multiple types of memory representations is a general mechanism that allows attention to select task-relevant information more quickly under a variety of situations.

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### Distractor Templates in Visual Search: Evidence for Within-Trial Adjustments of Attention to Actively Suppress Distractor-Related Information.

THOMAS TÖLLNER, MARKUS CONCI, HERMANN J. MÜLLER, *LMU Munich*.

One actively debated issue in cognitive neuroscience centres around the type of information that can be integrated by attention-guiding templates. Contemporary selective-attention models, for instance, envisage attentional templates to bias selection decisions exclusively through target-defining feature coding. Challenging this view, recent electrophysiological studies revealed that attentional selection times—as indexed by the PCN (aka N2pc) wave—are also modulated by distractor-related information. In particular, PCN times are speeded both when people can reliably predict the upcoming distractor-context across one block of trials, and when they have experienced a distractor-singleton on the previous trial. While this pattern demonstrates that search-guiding signals can integrate information about distractor identities to optimize



distractor-target competition, it remains controversial (i) whether people intentionally used distractor information in advance, and (ii) how fast this information can be implemented. To test these questions, we employed a cued additional-singleton task: in half of the trials, the pre-cue reliably indicated the featural identity of the upcoming distractor-context, the distractor-singleton, or the target-singleton, whereas no information as to the subsequent display was contained in the other half. For all three (blocked) cueing conditions, we observed faster RT and PCN times when the cue contained reliable information. Contrasting the cueing conditions revealed that people benefited most from the target cue, least from the distractor-singleton cue, and the cueing effect was of intermediate size for the distractor-context cue. Overall, these findings provide evidence that, within a single trial, people can tune their attentional settings to improve target search via intentionally suppressing distractor-related information.

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### **The Costs and Benefits of Chunking in Working Memory during Visual Search.**

RACHEL WU, *University of California Riverside.*

Previous studies suggest that only one attentional template can be prioritized at any given point. Grouping features into objects and objects into categories can facilitate search performance by maximizing the amount of information carried by an attentional template. A series of N2pc ERP studies shows that there are benefits and costs of chunking during visual search. Study 1 confirms that searching for 1 item (a letter) is more efficient than 2+ items (multiple letters) at both neural (attenuated N2pc) and behavioral levels (slower reaction time and lower accuracy). Study 2 shows that if category knowledge can be applied during visual search, 1-item (a letter) and multiple item search (any letter) is very similar. Study 3 extends this finding to real-world objects (clothing). Study 4 used novel stimuli to show that the N2pc is a marker of categorization. Regarding the costs of chunking, when asked to search for one item in a category (search for the letter "A") and another item from the category appears (the letter "R"), participants exhibit attentional capture the foil (the letter "R") at both neural and behavioral levels. Study 5 showed that the "foil effect" (presence of N2pc during foil trials) is predicted by the amount of natural experience (distinguishing healthy and unhealthy foods based on dieting intensity). Study 6 showed that the foil effect emerges over one experimental session via training with novel stimuli. These six studies investigate how we can overcome efficiency limitations in visual search, while constraining future search due to previous knowledge.

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### **Multiple Object Individuation and Aging.**

VERONICA MAZZA, *University of Trento.*

Processing multiple objects simultaneously is a core aspect of many tasks. Therefore, evaluating how this ability changes throughout lifespan is useful to assess the integrity of the cognitive functions in aging. I will discuss electrophysiological results in healthy aging that indicate a differential involvement of attentive individuation and WM procedures in multiple object processing. During exact enumeration in difficult perceptual contexts (cluttered scenes), where older participants performed worse than younger adults, the WM neural component (CDA) decreases with age only for large

numerosity sets (>3 targets), suggesting that the functioning of WM is preserved in aging for the numerosity range typically observed in subitizing (3-4 elements). In contrast, the attentive individuation neural component (N2pc) shows underactivation for all numerosities in old participants, suggesting that individuation is overall less functional during aging. However, age-related underactivation of the individuation neural counterpart is not always observed. In fact, when targets are presented in easy perceptual contexts (no cluttered scenes), an age-related overactivation of the individuation-related neural component becomes visible. This is associated to a comparable performance level between young and old participants. In line with theories on neural compensation (e.g. CRUNCH), these data suggest that aging is associated with compensatory effects that rely on the attentive mechanism responsible for target individuation (approximately 200 ms post-stimulus). In contrast, no modulation is visible for the WM component for easy versus difficult perceptual contexts. Overall, the findings support the view that attention and WM procedures are differentially involved during age-related changes in multiple object processing.

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### **When Updating Fails: Neural and Behavioral Evidence for a Resetting Process in Visual Working Memory.**

ROY LURIA, *Tel-Aviv University*, HALELY BALABAN, *Ben-Gurion University.*

One of the key characteristics of visual working memory (VWM) is that it tracks and updates any changes in the object status. However, sometimes it is impossible to keep updating existing representations, so that new representations must to be formed replacing the old ones. We refer to this process as 'resetting' of VWM contents, and provide evidence for this unique procedure. To study VWM representations as they evolve online, we relied on an electrophysiological marker of VWM contents, i.e., the contralateral delay activity (CDA), which is sensitive to the moment-by-moment development of VWM representations. We first demonstrate that when objects separated to their comprising parts (e.g., a shape that moved and broke apart to two shape-halves) there was a momentary drop in the CDA amplitude, a novel effect that implies that VWM had to reset its contents. Furthermore, a stronger objecthood cue prior to the separation, resulted in a more dramatic drop, while a weaker objecthood cue resulted in a steady rise in amplitude without a drop, following the separation. We also provide evidence that this resetting is followed by a period in which VWM is blind to changes in the objects status. We interpret these results by arguing that following the object separation, VWM has to reset (i.e., drop its contents) and only then it can re-encode the parts as individual items. In contrast, when the parts are easily identified prior to their separation, VWM can easily individuate them and update its representations, without the need for resetting.

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### **Discussant**

JOHN DUNCAN, *University of Cambridge.*

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MACHUCA ROOM,  
FRIDAY 6TH MAY, 8:20-10:00

## SY06 The Effect of Prior Brain States on Information Processing

### The Bayesian Framework for Information Processing and Minimisation of Uncertainty in the Brain.

NELSON TRUJILLO-BARRETO, *University of Manchester*.

A prominent theory of brain function articulated by Karl Friston proposes that the brain's main goal is to minimise uncertainty about its states and that of the environment by making predictions of the external causes of received sensory information, and updating those predictions dynamically. This talk is a tutorial introduction to the Bayesian framework, minimisation of surprise and how it might be implemented by the brain. We will use simple simulations to illustrate how this theory offers a computationally efficient, biologically plausible way of dynamically adapting to a changing environment.

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### Expectations as Efficient Information Processing.

WAEEL EL-DEREDY, *University of Manchester*.

**Objectives.** This talk uses the Bayesian framework as an inspiration to demonstrate experimentally in behavioural and neuroimaging data the efficiency gained during sensory processing by utilising prior information.

**Methods.** In 3 separate studies: object recognition, perceptual priming and placebo analgesia, we use signal detection in behavioural experiments, fMRI and EEG data to quantify the effect of prediction and priming on sensory and cognitive processing.

**Results.** Predictions speed up reaction times, facilitate object recognition and bias attention to towards rewards. However, this efficiency is at the cost of occasional perceptual errors, when predictions are strong while the actual sensory information is uncertain or impoverished. The placebo effect could be seen as a special case of such misperception.

**Conclusions.** The brain is Bayesian optimal, it integrates past experience and predictions with incoming sensory information to adapt to changing environment. Future work should focus on the psychological and neural processes of how this framework is implemented.

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### A Bayesian Model of Pain Self-Report Shows Variability in the Influence of Prior Expectations between Individuals.

DEBORAH TALMI, *University of Manchester*.

**Objectives.** When we expect pain to be intense we experience it as stronger than when we expect it to be less intense. An established research literature has shown that when people receive the same physical intensity of pain stimulation they report a higher, or lower, pain experience when they expect a higher or lower pain, respectively. We do not know, however, exactly what people care about or pay attention to when evaluating future pain. This is an obstacle when translating existing research to clinical settings.

**Methods.** Here we describe a new experimental task where we varied the mean and variance of expected pain in healthy volunteers,

and then delivered pain in the form of electric stimulation of the skin of the hand. We examined how volunteers' pain ratings was affected by prior expectation, time and delivered stimulus through a Bayesian hierarchical model that allows for individual-level heterogeneity. The random effects structure of the model allowed individual-specific estimates of the effect of expectation to be distilled from the data. These estimates we regard as individual-level measures of sensitivity to expectancy, and call Individual Expectation Scores (IESs).

**Results.** The proposed model, in combination with a Markov Chain Monte Carlo (MCMC) approach to inference, produced Bayesian credible intervals for the IESs, as a measure of their uncertainty. Expectation exerted on average a statistically significant effect on the rating, over and above that of delivered pain level. Important differences between the IESs of different individuals emerged from the analysis.

**Conclusions.** Our paradigm and model will yield stable estimates of between-subject variation in sensitivity to expectation, and assist in ranking of individuals according to this aspect of their personality. This can be useful in stratified medical decisions about treatment in acute and chronic pain settings

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### A Neurobiological Model of Expectancy Effects on Pain.

CHRISTOPHER BROWN, *University of Liverpool*.

**Objectives.** Research has discovered a range of neural responses to the anticipation of pain assumed to underlie the modulation of pain perception by expectations. However, a neurobiological model of expectancy effects on pain is still lacking. In this talk, insight will be provided on the basis of the cognitive modulation of anticipatory neural activity.

**Methods.** A number of studies were conducted using high-density EEG and source analysis to measure neural responses generated during anticipation of pain. Changes in the anticipation response, and correlated changes in subjective pain intensity and unpleasantness, were recorded as a result of experimental changes in expectation, uncertainty, attention, and after mindfulness training.

**Results.** Anticipatory neural responses in a "salience network" involving the anterior insula and midcingulate cortex predicted pain perception and its modulation by expectation, while stimulus-evoked responses in these regions were largely unrelated to changes in pain perception. Uncertainty, attention and mindfulness training modulated both anticipatory and stimulus-evoked responses within the salience and executive control networks.

**Conclusions.** Combining this EEG data with the results of complementary fMRI studies, a neurobiological model will be presented in which the salience network mediates expectancy effects on pain. Differential influences on the salience network from limbic and executive control networks are likely to depend on the individual's state of attention. Implications for the theoretical role of expectancy in pain perception will be discussed.

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### Effect of Expectation on Pre-Stimulus Alpha Activity and the Subsequent Subjective Experience of Pain.

DONNA LLOYD, LAURA ARENDSSEN, *University of Leeds*.

**Objectives.** Some evidence suggests a negative correlation between pre-stimulus alpha activity and the subjective experience of pain. However, findings with respect to alpha activity and pain processing have been mixed and only studied for a certain expectation of upcoming pain. In the current study, pre-stimulus alpha activity was studied for *uncertain* and *certain* expectation of the intensity of an upcoming pain stimulus.

**Methods.** A pressure pain stimulator was used to induce pain in healthy populations and a visual cue signalled whether the pain stimulus was of certain vs. uncertain intensity. Continuous electroencephalography (EEG) was recorded to assess changes in alpha activity and subjective ratings of pain intensity and unpleasantness were taken.

**Results.** Preliminary results indicate that subjective pain experience is significantly increased not only by the intensity of the pressure stimulus but also the degree of certainty of expectation. With respect to pre-stimulus alpha activity, there was no effect of pressure stimulus intensity or expectation. However, there was a significant change in alpha activity over time: alpha activity increased approaching pressure stimulus onset and decreased again immediately after pressure stimulus onset.

**Conclusions.** These findings suggest that, in pain-free populations, pre-stimulus alpha activity does not necessarily reflect pain experience, but may be more related to attentional or threat-related processing of upcoming pain. The aim of future studies will be to explore pre-stimulus alpha activity in chronic pain patients and any change in subjective pain experience following interventions that either directly or indirectly alter alpha brain activity.

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## MACHADO ROOM, FRIDAY 6TH MAY, 10:40-12:40 SY07 Current Directions in Hindsight-Bias Research

### The Role of Executive Function and General Attention in Hindsight Bias.

PATRICIA I. COBURN, *Simon Fraser University*; DANIEL M. BERNSTEIN, *Kwantlen Polytechnic University*.

Hindsight bias (HB), the tendency to overestimate previous knowledge once an outcome is known, can be measured using a memory design (participants recall original judgments) or a hypothetical design (participants judge how naïve others will respond). Using dual-task methodology we examined the role of executive function and general attention in HB measured using a memory design. In Experiment 1, we randomly assigned participants (N= 49) to either an inhibition or updating executive function distraction condition. Participants first answered trivia questions and identified distorted songs and pictures. They then learned the answers to the questions as well as the identities of the songs and pictures before recalling their prior answers and identification performance. Participants recalled under full and then divided attention involving a tapping task associated with inhibition or updating. Participants demonstrated the same degree

of HB whether distracted or at full attention. In Experiment 2, we randomly assigned participants (N= 139) to one of five between-subjects distraction conditions (no distraction, general attention, inhibition, set-switching, or updating). Again, participants demonstrated the same degree of HB whether distracted or at full attention. Together our results show that taxing executive function does not impair HB performance and that HB may occur automatically, regardless of available cognitive resources. Future research will use a hypothetical HB design to explore differences in the role of executive function and attention between hypothetical and memory HB designs.

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### Hindsight Bias and Inhibitory Control across the Lifespan.

RÜDIGER F. POHL, NINA R. ARNOLD, *Universität Mannheim*, UTE J. BAYEN, *Heinrich-Heine-Universität Düsseldorf*.

Hindsight bias is the tendency to overestimate one's prior knowledge or prediction of events after learning the actual fact. Recent theoretical approaches suggest that hindsight bias and especially age-related differences in hindsight bias, could be based on individual differences in inhibitory control. Less inhibitory control should accordingly lead to larger hindsight bias. We tested this proposed relationship with a large lifespan sample (including participants from different age groups) by running a standard hindsight-bias study and employing a battery of cognitive tests to tap inhibitory control. In addition, we included an experimental manipulation devised to trigger different inhibitory processes. Standard as well as multinomial model-based analyses showed hindsight bias in all groups and conditions and followed a u-shaped function with young adults showing the least bias, whereas children and older adults showed a larger bias. Similarly, most of the cognitive tests revealed an inverted u-shaped pattern, with young adults showing the best inhibitory control, whereas children and older adults showed poorer performance. Yet, the age-controlled correlations between hindsight bias and inhibitory-control measures were small and mostly not significant. Thus, we found no support for the impact of inhibitory functions on age-related differences in hindsight bias.

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### The Use of Hierarchical Multinomial Modeling in Decomposing the Hindsight Bias.

NINA R. ARNOLD, *Universität Mannheim*, JULIA GROß, *Heinrich-Heine-Universität Düsseldorf*.

After learning about facts or outcomes of events, people tend to overestimate what they knew about these events beforehand. In a typical study investigating hindsight bias memory distortions, participants provide original judgments to difficult questions (e.g., "How many prime numbers are included in the interval between 1 and 1000?") and must later recall these judgments. For experimental items, as opposed to control items, the correct judgment is provided before recall. In this case, participants typically recall their judgments with lower probability (recollection bias). If recall of the prior judgment fails, its reconstruction is biased towards the correct judgment (reconstruction bias). The separate contribution of both biases to hindsight bias can be estimated using multinomial model-based analyses (HB-13 model; Erdfelder & Buchner, 1998). However, when multinomial modeling is applied



to aggregated data for special populations (e.g., clinical groups, age groups), within-group variation of the relevant variables (e.g., level of depressive symptoms, age) may lead to biased parameter estimates and model-fit statistics (Smith & Batchelder, 2008). The latent-trait approach (Klauer, 2010) and the beta-MPT approach (Smith & Batchelder, 2010) are hierarchical extensions that capture parameter heterogeneity, and have successfully been applied to multinomial models of memory (Arnold, Bayen, & Smith, 2015). We re-analyzed data from several hindsight bias experiments (e.g., involving different age groups; Groß & Bayen 2015) by applying the two hierarchical approaches. We present results of model fit and parameter estimation and discuss applicability of both approaches to the HB-13 model.

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### Inevitability and Foreseeability of Events.

HARTMUT BLANK, *University of Portsmouth*, SASCHA KRAUSE, *University of Leipzig*, AILEEN OEERST, *Knowledge Media Research Center Tübingen*, STEFFEN NESTLER, *University of Münster*.

Hindsight encompasses three dissociable aspects, impressions of inevitability ('creeping determinism'), impressions of foreseeability ('knew-it-all-along' feelings), and hindsight memory distortions. Previous research (Blank & Nestler, 2007; Nestler & Egloff, 2009) has demonstrated that inevitability and foreseeability impressions can have different trajectories (e.g. an increase of perceived inevitability after having received an explanation of a surprising or disappointing outcome, but a concomitant decrease in foreseeability), as a function of certain factors, procedures and processes in naturalistic or experimental settings. The present research, by contrast, explores differential perceptions of the inevitability and foreseeability of event outcomes as a function of the nature of the events themselves – are there events that are in and of themselves (perceived as) more or less inevitable or foreseeable? To address this issue, we asked participants to rate the inevitability and foreseeability of a broad range of 30 generic events (e.g. marriage, illness, unemployment, war, weather, sports and historical events, donating money, having an argument, etc.). Ratings were made using the same 1 to 6 response scale. Significant differences between their perceived inability and foreseeability emerged for many of the events. Interestingly, these differences could go either way: Some events were perceived as clearly more inevitable than foreseeable (e.g. earthquakes) and others as clearly more foreseeable than inevitable (e.g. receiving money gifts at one's birthday). We propose a tentative explanation of these substantive differences in terms of controllability and natural laws vs. human agency and discuss implications for hindsight research.

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### The Role of Hindsight Bias in Depression.

JULIA GROß, UTE J. BAYEN, ANNA-CHRISTINA BREUER, *Heinrich-Heine-Universität Düsseldorf*, HARTMUT BLANK, *University of Portsmouth*.

Cognitive processes underlying hindsight bias are well understood, but little is known about how it may play a role in affective regulation and affective disorders. In this study we investigated whether hindsight-related judgments of self-relevant event outcomes depend on the presence of depressive symptoms. A total of sixty participants, of which  $N = 26$  had at least mild depressive

symptoms ( $BDI-II > 13$ ), listened to everyday-life scenarios that turned out either positively or negatively. Participants imagined themselves in these situations and subsequently judged the outcomes' foreseeability and inevitability (two facets of hindsight bias), responsibility for the outcomes as well as anticipated affective reactions. Results clearly showed that with higher levels of depressive symptoms, negative outcomes – but not positive outcomes – were rated as more foreseeable and more inevitable. In addition, higher levels of depressive symptoms were associated with higher responsibility for negative and lower responsibility for positive event outcomes. Responsibility, not hindsight bias, was associated with negative affect. The results thus show that hindsight bias plays a prominent role in depression. Its effect on affective reactions may however be an indirect one.

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### Discussant

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## PICASSO ROOM, FRIDAY 6TH MAY, 11:00-12:40 SY08 Human and Digital Memory

### Remembering and Forgetting Events.

JEFFREY M. ZACKS, *Washington University*.

In the laboratory, the "episodes" in episodic memory can be constructed from controlled materials such as list of words or pictures. In the real world, episodes must be constructed during encoding and that structure leaves its fingerprints on subsequent memory. Data from individual differences, neuropsychology, and neuroimaging suggest that the construction of events during perception is functionally significant for memory and can be impaired by neurological injury or disease. New results indicate that it is possible to improve the encoding of event structure and that this may improve subsequent memory. Such results have implications for technology design and for the remediation of memory disorders in conditions including healthy aging, Alzheimer's disease, and post-traumatic stress disorder.

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### Retrieval-Induced Forgetting and Digital Life-Logging.

GEOFF WARD, CATERINA CINEL, CATHLEEN CORTIS, *University of Essex*.

In RECALL, we attempt to augment human memory using recent advances in life-logging technology. In two sets of experiments, we examine whether reviewing captured images could not only enhance later accessibility to the reviewed items through retrieval practice, but could, potentially, also attenuate later accessibility to related events through retrieval-induced forgetting (RIF). In Experiment Series 1, we replicated classic effects of retrieval practice and RIF with category-exemplar semantic stimuli, but we found only retrieval practice and no significant RIF using labelled photos from fictitious holiday events and from the selective review of photos from participants' personal photo albums. Moreover, these findings were replicated when classic and fictitious holiday event stimuli were compared under exactly equivalent methodologies. In Experiment



Series 2, we explored factors that could selectively enhance and/or attenuate the effects of retrieval practice and RIF. Using classic category-exemplar semantic stimuli, we found that retrieval practice (but not RIF) was enhanced through increasing the number of repetitions in the retrieval practice phase, whereas RIF (but not retrieval practice) was enhanced through increasing the number of different related exemplars that were practiced. Increasing the number of category exemplars did not affect the magnitude of either effect. We discuss these results within the possibility an end of day “intelligent review” in which the “highlights” of the day together with capture data from earlier events are re-presented to augment later recall of to-be-remembered practiced items, and decrease accessibility to to-be-forgotten events that are related to those that are reviewed.

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### **A Fuzzy Trace Theory of Risky Decision Making.**

VALERIE F. REYNA, *Cornell University*.

Understanding risky decision-making is central to economic and psychological theory. Fuzzy-trace theory builds on prior theory, but makes unique predictions about the causes, development, and malleability of risk preferences. In particular, fuzzy-trace theory differs from other dual-process models in distinguishing impulsivity from intuition and in emphasizing that intuition is advanced. Most important, fuzzy-trace theory emphasizes that simple gist representations of the *meaning* of information underlie insightful intuition. These assumptions explain adolescent risk taking, much of which is surprisingly cold and calculating—rather than emotional and impulsive—as well as the growth of reliance on gist-based intuition with experience and expertise. Tested in randomized controlled experiments, the theory has been successfully applied to such domains as HIV prevention, medication decisions, and breast cancer and genetic risk.

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### **Preserving and Forgetting in Human and Digital Memory.**

ROBERT H. LOGIE, MARIA WOLTERS, ELAINE NIVEN, *University of Edinburgh*.

The human ability to summarize and contextualize elegantly complements the human tendency to forget by storing only those details from experiences that are necessary for retaining a record of those experiences, for accumulating knowledge about the world, for allowing us to understand events around us, and for ensuring that we act in an appropriate way for the current situation. Digital systems can now store very large volumes of information regardless of whether or not it is worth storing, making retrieval of specific, useful information increasingly difficult. However, systems that allow selective forgetting of digitally stored information that is no longer useful, is incorrect, or is not worth storing, are rare. This talk will present recent research that has drawn on the understanding of human remembering and forgetting in working memory and episodic memory to develop computer storage systems that can undertake intelligently managed archiving and forgetting, and that are designed to support, not to replace human memory. We will present empirical research that used photographs of personal events, showing that an automated digital preservation and forgetting system can support human participants when making ‘keep and

delete’ selections, but that many selections still require human intervention. We will also present an initial theoretical framework intended to explore a possible synergy between biological and digital remembering and forgetting.

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### **Schema Emergence during Processing: Long Term Memory Simulations.**

GISELA SUSANNE BAHR, WILLIAM ALLEN, PHILIP BERNHARD, STEPHEN WOOD, *Florida Institute of Technology*.

Viewing Human Long Term Memory from a set-theoretical perspective creates the mathematical foundation that supports modelling and simulation of human memory with big data storage and management systems. The current study uses the cognitive memory architecture Ardemia, which is built on a relational database management system, to investigate mechanisms for data reduction and schema emergence in an artificial long term memory. The artificial memory belongs to a fictitious character created by H.G. Wells, Mr. Alfred Polly, and contains data representing 6 months of episodic memory in 1 hour intervals. A series of memory probes reveal typical events, cognitive schemas and scripts, indicating that Mr. Polly’s artificial memory is capable of producing answers that are not explicitly coded as data, links or data containers but instead emerge during query processing. The results suggest that schemas are not hard-coded but can be generated “on the fly.” As such they are based on the current data and emerge as the interaction of data and process. The underlying operations and data reduction mechanism of the memory probes are presented in relational algebra, and the query design for probe implementation as a database query are presented in structured query language. The findings indicate that artificial memories can be simulated using a parsimonious storage model for schemas that are based on prior knowledge but remain malleable.

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## **MACHUCA ROOM, FRIDAY 6TH MAY, 11:20-12:40 SY09 Spatial Mappings of Time and Number: Commonalities and Distinctions**

### **How Vision Shapes Spatial Representations of Time and Numbers.**

ROBERTO BOTTINI, *University of Trento*.

Across many cultures people conceptualize time and numbers as extending along horizontal mental lines. The Mental Time Line (MTL) and the Mental Number Line (MNL) share many features and have been hypothesized to depend on common neurocognitive mechanisms for representing time, number, and space. Contrary to this hypothesis, research involving blind individuals reveals a dissociation between the MNL and the MTL. Both the MNL and the MTL develop in the absence of vision, yet, whereas the MTL is based on the same external frame of reference in sighted and blind, the MNL depends on different spatial coordinates across the two groups. Numbers are spatially represented in anatomical spatial coordinates in congenitally blind individuals (i.e. low-



numbers/left-hand; high-numbers/right-hand), and external spatial coordinates in sighted and late blind individuals (i.e. low-numbers/left side of space; high-numbers/right side of space). If the MTL and MNL were underlyingly the same, then they should be based on the same spatial FoR, and changes in people's experiences (e.g., due to sensory deprivation) should have similar effects on the spatial FoRs used for time and for number. Instead, the preferential use of different spatial coordinates to represent the MNL and the MTL in the congenitally blind suggests that spatial representations of time and number rely on partially different mechanisms and may have different experiential bases.

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### Space-Time Distortions Mirror Space-Number Distortions in Neglect Patients.

MARIO BONATO, *University of Ghent*.

Spatial compatibility methods can help in determining the presence of overlaps between the domain of space, time and number. In this study they were implemented to test right-hemisphere damaged patients suffering from spatial processing disorders (hemispatial neglect). We reasoned that, if the processing of time-ordered events is spatial in nature, it should be impaired in the presence of neglect and spared in its absence. To this aim, patients (with and without left neglect) memorized a brief story encompassing seven events. Then they categorized an image taken from the story as occurring before or after a temporal reference (central event). An asymmetric distance effect emerged, in neglect patients only, with slower responses to the events that took place before the temporal reference. The event occurring immediately before the reference elicited particularly slow responses, closely mirroring the pattern neglect patients show in numerical comparison tasks for the number immediately smaller than the reference. The first item of the sequence elicited significantly slower responses than the last one, indexing a preference for left-to-right mental scanning. Patients without neglect showed a regular, symmetric distance effect with slower responses for items closer to the temporal reference. The strong similarities patients showed between experienced space and temporal sequences in memory provide compelling evidence that the representation of events order is subserved by spatial mechanisms. The way order is processed calls for a close cross-dimensional overlap and might constitute the missing link to understand common spatial mechanisms underlying the processing of time and number.

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### Experiential Origins of the Mental Time Line and the Mental Number Line.

BENJAMIN PITT, *University of Chicago*.

People conceptualize both time and numbers as unfolding along a horizontal line, either from left to right or from right to left. The directionality of the mental timeline (MTL) and mental numberline (MNL) have both been assumed to depend on the direction of reading and writing within a culture. Here we challenge this assumption, proposing that different culture-specific experiences determine the directions of the MTL and the MNL. First, we tested the effects of reading direction on the direction of the MTL and MNL. Participants read English text either normally (from left to right) or mirror-reversed (from right to left). After normal reading, participants showed the space-time associations and space-number associations

typical of Americans. After mirror reading, participants' space-time associations were significantly reduced but their space-number associations were unchanged. Next, we tested the hypothesis that finger-counting habits can determine the direction of the MNL. English speakers were trained to count on their fingers from left to right or from right to left. After rightward counting, participants showed implicit associations of small numbers with left space and large numbers with right space, typical for Americans. After leftward counting, this space-number association was significantly reduced, overall, and was qualitatively reversed in a significant proportion of the individual participants. These data suggest that the MTL and MNL have different experiential bases. Whereas the MTL can be shaped by reading direction, the MNL is sensitive to other culture-specific practices that, like finger counting, spatialize numbers.

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### Relationships between Space, Time, and Number: Insights from Language Acquisition.

DANIEL CASASANTO, *University of Chicago*.

Space, time, and number are intertwined in the human mind, but the precise relationships among these domains remain controversial. According to one theory, spatial, temporal, and numerical magnitudes are all represented by a shared Generalized Magnitude System (GMS). Hundreds of experiments have been interpreted as support for a GMS. This talk will review the conclusions of a comparatively small number of experiments (about two-dozen) my collaborators and I have conducted to contrast the GMS proposal with an alternative proposal that follows from Metaphor Theory (MT): Perhaps space, time, and number do not share a domain-general GMS. Rather, people use space as a representational scaffold for time, number, and many other domains. Whereas the GMS implies there should be symmetric interactions between pairs of domains, MT predicts that cross-domain interactions should be asymmetric, even in experiments where magnitude-irrelevant factors are controlled. Many such experiments have shown the asymmetry predicted by MT, in adults and school-aged children. Yet, previous data leave open a possibility embraced by some GMS theorists: that cross-domain relationships start out symmetric, and only become asymmetric through the process of language acquisition. This possibility is challenged by new studies of adult-to-child and child-to-adult speech in the CHILDES corpora. Preschoolers' first uses of magnitude terms do not reflect the statistics of adult speech. The input-output mismatch in language learners' speech suggests that conceptual cross-domain asymmetries guide the process of language acquisition, rather than resulting from it.

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PICASSO ROOM,  
FRIDAY 6TH MAY, 15:40-17:00  
**SY10 New Approaches to the Study of  
Social Aspects of Memory**

**The Evolution of Embodied Memories as Effect of Social Interaction.**

LUCAS M. BIETTI, ADRIAN BANGERTER, *University of Neuchâtel*.

This study provides new empirical evidence regarding how memories based on personal experiences evolve and are learnt throughout series of transmissions over time. Despite the fact that experimental research on conversational remembering has revealed much about the malleability of human memory in conversations, little attention has been paid to the ways in which communication and repeated reproduction may affect the embodied features of individual memories over time. In order to tackle some of these issues that create the conditions for the spreading of memories and skills across different individuals and social groups during face-to-face social interactions, we conducted a study examining the serial reproduction of memories and performances collected in a joint complex task under different conditions and across transmission chains. The task involved preparing ravioli. Transmission chains were interactive and video-recorded in order to see and understand better the embodied features of informational transfer, as captured by the physical task of ravioli making. Our preliminary findings suggest that the embodied communication of memories over transmission chains gradually affected the amount of information communicated. That is, memories became conventionalized (e.g. gradual loss of embodied features) as they move away from the original event within the communication chains. Such conventionalization affected task performance in the joint task.

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**Collaborative Remembering of WWII Memories through Families' Discussion.**

AURELIE VAN DER HAEGAN, *Université catholique de Louvain*, CHARLES B. STONE, *John Jay College of Criminal Justice*, OLIVIER LUMINET, *Université catholique de Louvain*, WILLIAM HIRST, *New School for Social Research*.

How memories of historical events are transmitted by each generation to their children and grand children? In order to examine this crucial and understudied topic, we examined how WWII memories are remembered by three generations of Belgian french-speaking families. We used the individual interviews of each participant as described in Stone & al. (2014) to compare the content (family vs. institutionalized memory) with the family interview. Our work is grounded on the transactive memory theory (Kerr & Tindale, 2004), which hypothesizes that people remembering together will have higher recall than if they are alone. We also analyzed how the conversational roles of each participant in the triad (Hirst & al., 1997) had an impact on the content of the family interview. The results didn't show better recall in the family discussion in comparison with the individual interview. The conversational roles could be an explanation for this lack of effect. Indeed, the role of expert (or narrator) is only taken by the oldest generation, who lived through the event. They tend to impose what they lived through and what they know, which could then inhibit the other generations' interventions.

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**Collaboratively Crafting a Story (Model): The Mnemonic Consequences of Socially Shared Retrieval-Induced Forgetting Within Jury Deliberations.**

CHARLES B. STONE, *John Jay College of Criminal Justice*, FATIMA HAQUE, *Graduate Center, City University of New York*. Juries play a crucial role in the American justice system. Juries are composed of a group of peers tasked with observing a trial, deliberating about the facts of said trial and coming to a decision of guilty or not guilty based on the evidence. Given their critical role in the American justice system, it is imperative to understand how jurors come to their decisions in order to ensure their decisions are as accurate as possible. Using the social memory paradigm socially shared retrieval-induced forgetting (Cuc, Koppel & Hirst, 2007) and story model (Pennington & Hastie, 1986), the present study examined the extent to which the deliberation between two jurors shapes the way they remember the facts of the trial and, in turn, their verdict. The results found the standard social shared retrieval-induced forgetting and within individual retrieval induced forgetting as a result of the deliberation. However, there was no evidence to suggest that this forgetting impacted their verdict. These results are discussed in terms of the importance of understanding the mnemonic and decision-making consequences of jury deliberation. Contact Information: Charles B. Stone, [chstone@jjay.cuny.edu](mailto:chstone@jjay.cuny.edu)

**Joint Encoding Effects on Memory: The Role of Oxytocin and Physical Co-Presence.**

ULLRICH WAGNER, GERALD ECHTERHOFF, *University of Münster*.

The neuropeptide oxytocin has been implicated in a variety of social cognitive processes but little is known about its role in social memory. As one exception, some evidence suggests that oxytocin enhances the recognition of faces—stimuli with supreme social relevance. We investigated whether oxytocin affects incidental memory for standard stimulus material depending on the social encoding context. Building on Eskenazi et al. (2013), pairs of participants categorized words (1) jointly vs. individually (stimulus-independent social context) and (2) with different categories assigned to self and the partner (stimulus-related social context). Whereas participants sat next to one another in Eskenazi et al., they sat in separate cubicles in our study, eliminating attention-grabbing sensory cues such as the partner's movements or button-press sounds. According to the social-salience hypothesis, oxytocin should enhance memory encoding under joint encoding and for words assigned to the partner. Male participants, invited in pairs, received either oxytocin (24 I.U.) or a placebo intranasally and performed the word categorization task 45 minutes later. After 24 hours a surprise memory test was administered individually. We found a main effect of oxytocin on recognition (increased hit and false alarms rates), but no interaction with social context conditions. In contrast to Eskenazi et al., the memory enhancement for partner-assigned stimuli was found in both the joint and the individual encoding condition. Thus, without physical co-presence during encoding, memory was affected by stimulus-related social factors, but this effect was not sensitive to oxytocin. We discuss implications of these findings.

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MACHUCA ROOM,  
FRIDAY 6TH MAY, 15:40-17:00  
**SY11 The Roots of Human  
Metacognition**

**The Evolutionary Roots of Metacognition.**

J. DAVID SMITH, BARBARA A. CHURCH, MICHAEL J. BERAN, *Georgia State University*.

Humans feel uncertain. They know when they do not know. These feelings and the responses to them ground the literature on metacognition and metamemory. It is a natural question whether animals share this cognitive capacity, and thus animal metacognition has become an influential research area. This research might reveal aspects of reflective mind in animals. It might reveal the earliest evolutionary stages and forms of humans' cognitive self-awareness. In my talk, I will introduce this area and the symposium, I will begin with intriguing research from a bottle-nosed dolphin (*Tursiops truncatus*) who explains why uncertainty monitoring has seemed psychologically special to theorists for 100 years. I will summarize provocative (negative) evidence on metacognition from species like pigeons (*Columba livia*). Even capuchin monkeys (*Cebus apella*, a New World species) have achieved notable failures in the domain of metacognition. My talk will lead up to the sometimes sophisticated uncertainty performances of rhesus monkeys (*Macaca mulatta*). It even appears that—when they declare their uncertainty behaviorally—this is a working-memory-intensive response that has a distinctive psychological character. There is an emerging consensus that animals share functional parallels with humans' conscious metacognition. But there are still important questions to answer about the relationship between this capacity and the verbal-introspective, self-imbued capacity of humans. How high should we set the bar for concluding that animals share metacognition with humans? Is metacognition a unitary, self-awareness capacity, or a suite of apps, suggesting animals might share some facets but not others?

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**Metacognitive Monitoring during (Implicit) Procedural Learning.**

F. GREGORY ASHBY, VIVIAN V. VALENTIN, LAUREN VUCOVICH, *University of California*.

It is well established that humans can accurately monitor the status of ongoing cognitive processing in explicit tasks that require executive attention and declarative memory systems. Recently, we showed that humans have a similar ability to monitor their metacognitive uncertainty in tasks that are mediated by implicit, procedural (i.e., nondeclarative) memory. This result is curious since people appear to lack conscious access to the algorithms that select procedural responses. So a critical question arises. What is the source of uncertainty monitoring in implicit, procedural-learning tasks? A large literature suggests that procedural learning is mediated largely within the basal ganglia and depends heavily on plasticity at cortical-striatal synapses that follows reinforcement learning rules. We show that standard reinforcement learning algorithms discard uncertainty information, even when they produce highly accurate responding. Thus, procedural-learning systems seem incapable of uncertainty monitoring on their own. Together, these results suggest that humans should have some independent metacognitive systems

that evolved separately from procedural learning systems. We describe results from a recent fMRI experiment that supports this prediction and we describe a successful neurocomputational model of uncertainty monitoring during procedural learning.

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**Cognitive Monitoring and Cognitive Control in Monkeys.**

ROBERT R. HAMPTON, *Emory University*.

A potential function of metacognitive monitoring is to provide dynamic feedback on the status of ongoing cognitive processes to optimize cognitive control of those processes. Most of the work investigating metacognition in nonhumans has focused on the monitoring side of this interaction while minimizing the role that feedback based cognitive control might have on cognition. For example, metacognitive monitoring has been inferred when monkeys exert cognitive control in minimal ways, such as by avoiding tests or seeking information when ignorant. I will describe experiments from our lab in which we have begun to test whether metacognitive monitoring and control might interact in more dynamic ways in the contexts of recognition, working memory, and discrimination.

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**Information-Seeking Behavior and Confidence Judgments by Chimpanzees.**

MICHEAL J. BERAN, AUDREY E. PARRISH, *Georgia State University*, SARA E. FUTCH, *Wofford College*, BONNIE M. PERDUE, *Agnes Scott College*, J. DAVID SMITH, *Georgia State University*.

Metacognition is one of humans' most sophisticated capacities, but it also may be evident in chimpanzees. In one study, three language-trained chimpanzees performed an information-seeking task in which they had to provide the name of a food item in order to receive it. Sometimes, the chimpanzees were shown what was in an opaque container. In other cases, they were not, and so they had to look first if they had any chance to name the item correctly. The chimpanzees were significantly more likely to look into a container first on trials in which they could not know its contents but were more likely to name the item without looking into the container on trials in which they had earlier seen the contents of that container. In Study 2, chimpanzees performed computerized memory tasks in which auditory feedback about the accuracy of responses was delayed. The delivery of food rewards for correct responses also was delayed after auditory feedback, and reward delivery occurred in a separate location from the response location. Crucially, if the chimpanzees did not move to the reward-delivery site before food was dispensed, the reward was lost. The results showed that chimpanzees moved early (before any feedback) more often on trials that ultimately were correct than ultimately were incorrect. These results demonstrate that chimpanzees can monitor what they know or remember, and then respond either by seeking more information or by demonstrating their confidence through making more immediate responses.

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ANDALUCIA III ROOM,  
FRIDAY 6TH MAY, 17:20-19:00

## SY12 Big Data: The New Way Forward in Language Research

### ERP Kiloword Studies: Using Electrophysiological Data to Examine the Time Course of Word Processing to Written and Spoken Words.

PHILLIP J. HOLCOMB, KATHERINE J. MIDGLEY, KURT WINSLER, *San Diego State University*, STÉPHANE DUFAU, JONATHAN GRAINGER, *CNRS & University of Aix-Marseille*.

A number of previous studies have indicated that certain characteristics of words produce systematic differences in the timing/amplitude of ERP components suggesting that this technique can be used as a sensitive measure of moment-by-moment words processing. However, most of these studies examined either a relatively small number of words (< 100), a small number of participants (< 30), a single experimental task (e.g., lexical decision) or a single modality of language representation (usually visual words). Here we report a study looking at a large number of words (> 900), in two different modalities (visual/spoken) in a large number of participants (200), in two tasks. Participants processed words one at a time in one modality and made either go/no-go semantic categorization responses or lexical decisions to occasional probe items. ERPs were recorded to none-probe critical words that varied along a number of characteristics including length/duration, frequency, concreteness and orthographic/phonological neighborhood density. ERP responses were contrasted across the two modalities and two tasks for the above variables. We show that while there are clear similarities across modalities and tasks, there are also interesting differences in the timing and pattern of ERP effects.

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### Quality, not Quantity. Register is more Important than Size in Corpus-Based Frequency Estimation.

DAVIDE CREPALDI, *University of Milano Bicocca, Milan Center for Neuroscience*, SIMONA AMENTA, *University of Milano Bicocca*, PAWEŁ MANDERA, EMMANUEL KEULEERS, MARC BRYBAERT, *University of Ghent*.

Recent evidence has shown that word frequency estimates provide a better fit to experimental data when they are based on movie subtitles, as compared to other sources such as books or written text gathered from the Internet (Brybaert & New, 2009). Following this seminal paper, others have provided converging evidence from different languages (e.g., Cai & Brybaert, 2010; Keuleers and Brybaert, 2010).

In this paper we will present subtitle frequency estimates for Italian (SUBTLEX-IT) based on ~130M tokens, and we will validate them: (i) in both a lexical decision task and a more ecologically realistic eye tracking, sentence reading study; and (ii) both against a smaller (~4M tokens) corpus based on edited text (CoLFIS; Bertinetto et al., 2005) and a larger (~2B), web-crawled database (itWaC; Baroni et al., 2009). By doing so, we will yield three new contributions to the field. First, we will show that giant databases such as itWaC do not necessarily provide higher-quality frequency estimates, thus suggesting that register (i.e., quality) is more important than size

(i.e., quantity). Second, we will show that eye tracking, sentence reading data allow validation of frequency corpora just as well (or even better) than lab tasks such as lexical decision. Third, we will use these higher-quality frequency measures to assess the role of this variable (taken as a sign of lexical involvement) during the various stages of visual word identification in sentence reading.

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### Modeling Human Colour Preferences from Judgments of Random Colour Combinations.

GEOFF HOLLIS, CHRIS WESTBURY, *University of Alberta*.

There is a wealth of literature on human colour preferences (for reviews, see Whitfield Whiltshire, 1990; Crozier, 1996; Hurlbert & Ling, 2012; Palmer, Schloss, & Sammartino, 2013). However, our understanding of how preferences vary with respect to colour properties is very much in its infancy. In part this is because colour preferences appear to be context-specific and sensitive to interactions between a variety of colour properties, as well as culture and personal features, including gender. Theory-driven, experimental methodology is not well-suited for understanding this complex, interactive processing because of its necessary focus on controlling everything but a single dimension. Rather, approaches focusing on statistical modeling and machine learning are more suited for understanding the relationship between properties of colour appearance, context, and observer judgments. We describe three statistical models of judgments of preference that were derived from binary human rating data (like/dislike) of over a hundred thousand randomly-generated colour triads, analyzed to give us models of colour preference for singles, pairs, and triads of colour. The model accounts for almost as much variance in colour preference as human test-retest reliability data. It extends earlier work by suggesting that interaction effects between predictors are key for understanding human colour preferences. We also discuss recent work that extends our methodology to decision contexts with varying backgrounds, changing spatial organizations, and opposite-gender predictions of colour preferences.

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### Moving Beyond the Monosyllable in Models of Skilled Reading: Mega-Study of Disyllabic Nonword Reading.

KATHY RASTLE, BETTY MOUSIKOU, JASMIN SADAT, REBECCA LUCAS, *Royal Holloway, University of London*.

More than 90% of English words are polysyllabic, yet the vast majority of research on reading aloud has focused on monosyllables. We conducted a large-scale study in which 41 participants read aloud 915 disyllabic nonwords. Participants' reading aloud latencies, pronunciations, and stress placements were compared where possible to the performance of rule-based (DRC; Rastle & Coltheart, 2000) and probabilistic (CDP++; Perry et al., 2010; Seva et al., 2009) computational models of reading aloud. Nonwords yielded an average of six pronunciations each, with variability across participants strongly determined by the spelling-to-sound consistency of onset and rime units. Stress placements were influenced by a combination of orthographic and phonological cues, as well as spelling-to-stress consistency of onset and rime units. RTs were influenced by pronunciation and stress uncertainty across participants, as well as other item-level orthographic factors. The computational models under consideration showed a good fit to the human data in respect of stress assignment, with stress uncertainty

within the probabilistic models strongly related to stress uncertainty across participants. Furthermore, the models showed a reasonable fit to the human data in respect of nonword pronunciations, even though they yielded a number of pronunciations that no participant produced. We discuss several ways in which the data constrain further development of these models.

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### How many Words do we Know? Estimates of Vocabulary Size Dependent on the Degree of Language Input and the Participant's Age.

MARC BRYLSBAERT, MICHAËL STEVENS, PAWEŁ MANDERA, EMMANUEL KEULEERS, *Ghent University*.

Based on an analysis of the literature and a largescale crowdsourcing experiment, we estimate that an average 20 year old native speaker of American English has a receptive vocabulary of 42,000 lemmas and 4,200 non-transparent phrasal expressions, derived from 11,100 base words. The numbers range from 27,000 lemmas for the lowest 5% to 52,000 for the highest 5%. Between the ages of 20 and 60, the average person learns 6,200 extra lemmas or about one new lemma every two days. The knowledge of the words can be as shallow as knowing that the word exists. In addition, people learn tens of thousands of inflected forms and proper nouns (names), which account for the substantially higher numbers of 'words known' mentioned in other publications.

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MACHADO ROOM,  
FRIDAY 6TH MAY, 17:20-19:00

## SY13 Physical Activity and Cognitive Training for Healthy Brain Aging

### Life-Long Physical Activity Is Related to Higher Performance in Executive Tasks and Functional Brain Changes.

PATRICK D. GAJEWSKI, *Leibniz Research Centre for Working Environment and Human Factors (IfAdo)*, MICHAEL FALKENSTEIN, *Leibniz Research Centre for Working Environment and Human Factors (IfAdo)*, *Institute for Working, Learning and Aging, Bochum*.

Introduction. Aging is associated with the decay of cognitive functions, while physical activity has been shown to improve cognition. In the present study we investigated the impact of life-long physical activity on behavior and electrical brain activity in healthy old men.

Methods. Two matched groups of physically high vs. low active old men performed a large battery of paper and PC-based memory and executive tests. During the latter the EEG was recorded and event-related potentials (ERPs) computed, which reflect sensory and cognitive processes in different cortical areas.

Results. Group differences in performance and ERPs were only found for three tasks that tackle executive functions, an auditory distraction task, a modified Stroop task, and a memory-based task-switching task, while no group difference was found in memory tasks. In the Stroop and switch tasks a shorter latency of the P2 and a subsequent fronto-central negative shift were seen in the active

vs. passive seniors. The behavioral interference was related to the amplitude of that shift.

Discussion. The results suggest that lifelong physically activity does not improve memory but some executive functions, namely inhibition of irrelevant information and incorrect responses as well as working memory and task-switching. The ERP reveals that this improvement in the active seniors is mainly due to a sustained enhanced activity in prefrontal brain areas. An earlier P2 and increased fronto-central activity was also seen in normal young subjects, relative to passive seniors. Hence active old men show an ERP pattern, which resembles that of young subjects.

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### The Effect of Cognitive Training on the Brain Activation of Older Adults: A Test of the INTERACTIVE Model.

SYLVIE BELLEVILLE, BENJAMIN BOLLER, SAMIRA MELLAH, BIANCA BIER, ÉMILIE OUELLET, *Institut Universitaire de Gériatrie de Montréal and Université de Montréal*.

Objectives. Cognitive training can be used to increase resilience against age-related neurodegenerative diseases. Relying on task-related activation paradigms to examine the effect of cognitive training can shed light on the type of neuroplasticity processes engaged by therapeutic interventions. Past studies have indicated divergent patterns of activation changes following cognitive training. These differences might be explained by the use of diverse training modalities.

Method. A set of studies measured task-related activation with functional magnetic resonance imaging (fMRI) in healthy older adults and older adults with prodromal AD (subjective cognitive decline or mild cognitive impairment). The change in activation was compared as a function of whether training involved repeated practice or strategic learning.

Results. Results indicated increased activation within new alternative regions when training involves using new strategies but decreased activation when training involves repeated practice. We also found evidence that brain changes can occur both in functionally intact brain regions and in regions that are functionally impaired.

Conclusion. The INTERACTIVE model is used to interpret the brain imaging findings. It is proposed that the level and loci of training-related neuroplasticity vary as a function of whether the training is strategic or repetitive. Furthermore, brain changes indexing compensation and restoration processes can co-occur following cognitive training.

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### Engagement in Mentally-Effortful Activities Enhances Cognitive Function and Neural Efficiency in Older Adults.

DENISE C. PARK, IAN MCDONOUGH, SARA HABER, GERARD BISCHOF, *University of Texas at Dallas*.

Objectives. We hypothesized that engaging in enjoyable and enriching lifestyle activities would enhance cognitive and neural function in older adults based on the mental effort associated with engagement. We have reported memory facilitation in older adults who were randomly assigned to a high effort engagement condition (learning digital photography, quilting, or both for 15 hours a week for 12 weeks) in comparison to two control conditions that were low in mental effort: a social engagement group and a placebo



condition where participants worked on low-effort cognitive tasks that relied on use of previous knowledge. We report here fMRI results associated with levels of engagement.

**Method.** A total of 39 participants completed an in-magnet animacy judgment task that consisted of blocks of easy judgments (eg, dog, book, car), difficult judgments (eg, virus, ghost), or fixation at pretest and posttest.

**Results.** Participants in high-effort engagement conditions (photography and quilting) showed a pre-post increase in their ability to modulate their brain function to difficulty relative to control subjects in medial frontal, lateral temporal, and parietal cortex—regions associated with attention and semantic processing. This increased modulation stemmed from decreases in brain activity during the easy condition and was correlated with time committed to the program. The increased modulation in medial frontoparietal regions was maintained a year later.

**Conclusion.** Sustained engagement in cognitively demanding activities facilitated cognition by increasing neural efficiency. The maintenance of effects a year later suggests that mentally-challenging activities may be neuro-protective and an important element to maintaining a healthy brain into late adulthood

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### **Video Game Training Enhances Visuospatial Working Memory in Older Adults.**

PILAR TORIL, JOSÉ MANUEL REALES, JULIA MAYAS, SOLEDAD BALLESTEROS, *Universidad Nacional de Educación a Distancia (UNED)*.

**Objectives.** An important goal of current aging research is to find methods to maintain brain health and cognition. In a previous randomized controlled trial, we trained older adults with non-action video games and found significant improvements after training in the trained group, and no change in the control group in processing speed, attention and visual recognition but visuospatial WM did not improve. This new longitudinal intervention study was designed taking into account the results of our previous study and the findings of several meta-analyses to investigate the effectiveness of game training to improve visuospatial WM and 3-month maintenance.

**Method.** Two groups of healthy older adults participated in this longitudinal, the trained group who received 15 1-hr video game training sessions with a series of video games selected from a commercial package, and a control group. The design was a 2 group x 3 session (pre-training, post-training, 3-month follow-up) as independent variables.

**Results.** The results showed that trainees improved significantly in all the practiced video games. Most importantly, we found significant enhancements after training in the trained group and no change in the control group in two computerized tasks designed to assess visuospatial WM, namely the Corsi blocks and the Jigsaw puzzle tasks.

**Conclusion.** Gains in some WM tasks were maintained during a 3-month follow-up period. These results suggest that the aging brain still retains some degree of plasticity, and that video game training might be an effective intervention tool to improve working memory and other cognitive functions in older adults.

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PICASSO ROOM,  
FRIDAY 6TH MAY, 17:20-19:00

## **SY14 Benchmarks in Working Memory**

### **What Are Benchmarks and Why Do We Need Them?**

KLAUS OBERAUER, *University of Zurich*, STEPHAN LEWANDOWSKY, *University of Bristol*, THE WORKING MEMORY BENCHMARKS TEAM, *various affiliations*.

**Objectives:** As much as we wish to have a theory or model that explains all existing data in a field, this is probably unrealistic for cognitive psychology for the foreseeable future, except in very narrowly defined or very young fields. Theory building therefore would benefit from a consensus on which empirical phenomena any theory/model should explain with highest priority, so that they constitute benchmarks for models in the field. Benchmarks provide a basis for evaluating competing models against a common standard, thereby facilitating model comparison.

**Methods:** The Benchmarks Team consists of experts in working memory from a broad range of theoretical perspectives and specializations. The Team agreed on criteria for benchmarks: Replicability, generality, and diagnosticity for theoretical questions. The Team developed a preliminary set of phenomena meeting these criteria, and evaluated it through expert crowd sourcing (c.f. talk 2 by Lewandowsky et al.).

**Results:** A consensus document with a thematically organized set of benchmark phenomena for models of working memory, rated by priority on a three-point scale.

**Conclusions:** The wealth of data accumulated over decades of empirical work on a research object in cognitive psychology does not naturally converge to a coherent picture of that object. The more we know, the more challenging it becomes to construct a model that is both precise and integrative in its scope, and the gap between empirical knowledge and theoretical understanding widens. The joint effort of experts towards a consensus on benchmarks is necessary as an intermediate step between empirical discovery and theoretical integration.

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### **The Experts' View on Working Memory.**

STEPHAN LEWANDOWSKY, *University of Bristol and University of Western Australia*, KLAUS OBERAUER, *University of Zurich*, THE WORKING MEMORY BENCHMARKS TEAM, *various affiliations*.

Expert assessments are vital to create a snapshot of knowledge in an area of research. For example, the U.S. National Academy of Sciences is routinely called upon to summarize policy-relevant or contentious scientific issues for the benefit of policy makers, which may range from the effects of gun control on homicide rates to the extent of human influence on climate change. One way in which expert assessments can be compiled is by surveying experts in the field. This is common in areas such as climate science, where domain experts have been routinely surveyed about their opinions, but it is relatively rare in psychology. One instance of a survey-based expert assessment in psychology has been in the field of eyewitness testimony research (Kassin et al., 2001). This survey helped establish that there is "general acceptance" of various eyewitness phenomena within the scientific community, which is a criterion for the admissibility of scientific evidence in court. We





report the results of a survey of 156 experts on working memory who rated a large list of candidate phenomena for their applicability as a benchmark of working memory. The results revealed some striking uniformity as well as some intriguing diversity. For example, there was a broad consensus that accuracy of recall monotonically decreases with increasing list length, and that this phenomenon constitutes a benchmark of working memory. By contrast, there was no agreement whether the finding that around 4 items can be recalled after a very brief masked display of letters constitutes a benchmark. We summarize the experts' opinions about more than 100 phenomena in working-memory research and present a snapshot of expert knowledge in the field.

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### Can Phenomena Be Stated in a Theory-Neutral Manner?

NELSON COWAN, *University of Missouri*.

It is widely understood that observation and theory are intricately related. The question for our endeavor is whether one can describe benchmark observations in a theory-neutral manner. I will explore this question with respect to working memory capacity. One point is that theory guides observation. Miller (1956) noted that people can repeat lists of about 7 units, but subsequent work used theoretical assumptions to find conditions allowing a division of Miller's result into a core capacity of about 3 units and supplemental help from mnemonic strategies such as grouping and rehearsal. The relevant conditions, such as brief simultaneous presentation of stimuli in an array or the use of articulatory suppression, would seem arbitrary were it not for theory. A second point is that theory is used in measurement. In recognition procedures, responses can be partitioned into knowledge- and guessing-based proportions with theory-guided measures. I will argue that a healthy relation between observation and theory entails that (1) under certain specified conditions, certain results reliably obtain; (2) the conditions should be noted as emerging from theory in a particular manner; (3) if another, competing theory can account for the results under the same specified conditions, it too must be considered; (4) the competing theory might also lead to the specification of new conditions or measures to be examined; and (5) proponents of the first theory should then attempt to account for results obtained under the new conditions.

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### Using Benchmarks to Advance Working Memory Theory.

CANDICE MOREY, *University of Edinburgh*.

The findings chosen as benchmarks in working memory reflect uncontroversial empirical phenomena, whose robustness and consistency is broadly acknowledged. Yet many of these phenomena defy a common theoretical explanation; in some cases, theoretical disputes have survived decades of accumulating empirical evidence. One may reasonably wonder what purpose this evidence has served, if not to force theoretical perspectives to converge. An example of this gridlock is provided by theoretical explanations for how diverse information may be held in working memory. Baddeley and Hitch's (1974) seminal finding that some verbal information can be retained virtually without cost to various concurrent tasks arguably broke the standard classifications of memory storage and drove the development of multi-component models of working memory. Effects of maintaining multiple memory sets or of processing tasks on memory have proved remarkably consistent, but models

of working memory handle these benchmark findings with widely differing assumptions. I will explain how evidence from dual-task and dual memory set designs has historically guided the development of competing models of working memory, providing a useful constraint. Then, I will evaluate how these models handle a selection of specific benchmarks identified in the working memory benchmarks initiative. Differences in theoretical explanation of benchmarks will be highlighted, providing foci for model testing and novel empirical research.

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## FALLA ROOM, SATURDAY 7TH MAY, 8:20-10:00 SY15 Bilingual Reading and Language Control

### A Corpus Study of Bilingual Reading.

NICOLAS DIRIX, USCHI COP, WOUTER DUYCK, *Ghent University*.

In a megastudy, late Dutch-English bilinguals and monolingual participants read an entire novel while recording their eye movements. The bilingual participants read the novel half in Dutch and half in English, the monolinguals only read in English. This approach yielded a unique dataset with hundreds of thousands of fixation points. We will discuss some of the results that we obtained by analyzing data of the corpus. First, we will present reading differences between L1 and L2 reading on one hand and bilingual and monolingual reading on the other hand. Second, we looked into some effects at the word level in depth, such as word frequency effects, cognate facilitation and (cross-lingual) neighborhood density and frequency effects. Finally we will present the outcomes of our latest study, where we investigated the effect of L1 and L2 word-level age-of-acquisition on reading times. There seemed to be a complex pattern of L1 and L2 AoA effects on bilingual reading, which also allows to make inferences about the origin of AoA effects.

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### Learning a New Language in the Elderly.

JON ANDONI DUÑABEITIA, MANUEL CARREIRAS, *BCBL San Sebastian*.

Which are the cognitive mechanisms that predict efficient bilingual reading and the development of reading skills in a recently acquired language? In spite of the importance of this issue, researchers don't fully understand the manner in which bilingual reading is attained, and the factors mediating this milestone. In the current study we explored this issue by analyzing different constructs that have been shown to mediate efficient visual word recognition, and to do so we focused on a very rare population: monolingual seniors acquiring a new language in the elderly. In the present longitudinal study, a group of elderly Spanish monolinguals completed a language learning course during a whole academic year in which they acquired



Basque as a second language, while we monitored the common symptoms of age-related cognitive decline as well as the seemingly preventive effects acquired bilingualism may have on such decline. Before and after completing this language course, participants were administered a battery of tasks including, crucially, two measures of their ability to extract visual statistical regularities: a visual-statistical-learning task with sequences of shapes, and a language decision task with strings containing Spanish and Basque bigrams including language-specific orthographic statistical regularities (language-dependant orthotactics). Recent evidence suggests that visual statistical learning abilities are good predictors of language learning, but at the same time the developmental course of such abilities suggests that they are relatively impaired in the elderly. The results showed that participants performed at chance level in both tasks on both occasions (before and after completing the course) in spite of successful learning of the second language, demonstrating that, while the elderly are certainly capable of learning and acquiring new languages, they do so via different mechanisms not involving the focusing on statistical regularities, which the elderly are not able to register.

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### **How Does Switching Direction Affect Reading and Listening to Code-Switched Sentences? Electrophysiological and Behavioral Evidence.**

JANET G. VAN HELL, CARLA B. FERNANDEZ, KAITLYN A. LITCOFSKY, *Pennsylvania State University*.

A hallmark of bilingual speech is that bilinguals often alternate between their two languages, as in "I ate huevos para el desayuno". While this code-switching is seemingly fluent in natural conversation, neurocognitive studies on intra-sentential code-switching have found that the comprehension of code-switches, as compared to non-switches, incurs increased processing demands. However, these studies have not systematically examined whether language switching direction (switching from the first (L1) to the second language (L2), or vice versa) modulates processing. In a series of behavioral and event-related potential (ERP) experiments, highly proficient Spanish-English bilinguals read or listened to code-switched sentences (switching from L1 to L2 and from L2 to L1) and non-switched sentences (in L1 and L2). When participants read the sentences, reading times showed a cost for code-switched words in both switching directions. ERPs showed that code-switched, as compared to non-switched, words elicited a late positivity (LPC) and this effect was only present when reading sentences that switched from the dominant to the weaker language, not vice versa. Listening to sentences also elicited an overall effect of code-switching, but these effects patterned differently. Switching from the dominant to the weaker language elicited an LPC (like in reading), but also a frontal negativity. Moreover, a widespread negativity was evoked for switches from the weaker to the dominant language (unlike in reading). These converging and divergent results will be discussed in terms of the neurocognitive mechanisms involved in comprehending code-switched sentences, focusing on effects of switching direction and modality.

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### **Bilingual Inhibition during Naming and Reading: Evidence from N-2 Language Repetition Costs.**

MATHIEU DECLERCK, *Marseille University*, PHILIPP ANDREA, *Aachen University*, JONATHAN GRAINGER, *Marseille University*.

Many models assume that inhibition plays an integral part during bilingual language control (i.e., a process that restricts bilingual language processing to the target language). However, there is limited evidence for such a claim. In the current study, we set out to investigate one known marker of inhibition (i.e., n-2 language repetition costs) that has solely been investigated with digit naming. In the current study, we investigated n-2 language repetition costs during picture naming and written word reading. Several studies demonstrated that picture naming requires lexical-semantic processing, whereas written word reading mainly relies on phonological processing. Since most bilingual inhibition models assume that inhibition is implemented during lexical-semantic processing, little to no n-2 language repetition costs should be found during written word reading, but large costs are expected during picture naming. These results showed that n-2 language repetition costs were found during both naming and reading, but were smaller with the latter. Our results clearly indicate that inhibition is implemented during both bilingual naming and reading, even though less inhibition is implemented during reading due to a lexical-semantic locus of inhibition.

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### **Word Processing: Semantics and Beyond.**

A. FOUCART, *University Pompeu Fabra*, MARTIN C. D., *BCBL San Sebastian*, MORENO E., *University of Madrid*, G. THIERRY, *Bangor University*, A. COSTA, *University Pompeu Fabra*.

Processing a word goes beyond getting access to its meaning and setting it in its semantic context; the message it conveys also needs to be interpreted. To do so, other sources of information, such as pragmatic information, need to be processed as well. Although native speakers seem to retrieve pragmatic information rapidly and incrementally when reading, evidence that late bilinguals also do so is scarce. In two ERP studies we investigated whether late bilinguals use their knowledge of the world (Martin, Garcia, Breton, Thierry, & Costa, 2015) and their personal values (Foucort, Moreno, Martin, Costa, 2015) when processing words. Results showed that late bilinguals, like native speakers, rapidly access their world knowledge to check the veracity of a fact. Hence, in sentences like 'Mozart composed jazz music', processing the word 'jazz' provokes an N400, reflecting semantic integration difficulties. On the other hand, when the interpretation of a word depends on personal affect, like in 'Divorce is unacceptable', valuation is integrated online (as reflected by an affect-related response, LPP), but unlike in first language, it does not seem to interfere with semantic processing (absence of N400). Overall, these studies show that late bilinguals use semantic and pragmatic information when reading words. However, depending on the origin of the source (e.g., facts or personal affect), a word online interpretation does not always affect the same processes as in native speakers.

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ANDALUCIA III ROOM,  
SATURDAY 7TH MAY, 8:00-10:00

## SY16 Exploring Relationships between Two-Process Theories of Attention Shifting and Dual-Stream Models of Vision

### Effects of Cue Exposure Time and Luminance Contrast on Attention Shifting in Response to Landmark Cues and Identity Cues.

JAIMIE WILKIE, EVATTE SCIBERRAS-LIM, ANTHONY LAMBERT, *University of Auckland*.

Objectives: To test the proposal that spatial cueing effects driven by landmark features, and those driven by the identity of peripheral stimuli, rely on encoding within the dorsal and ventral visual streams respectively

Methods & Results: Participants shifted spatial attention in response to bilaterally presented cue letters. In the landmark procedure, two different letters were presented on every trial, and targets were likely to appear near to a specific 'landmark' (e.g. the letter X). In the identity cueing procedure, two identical letters were presented on every trial, and participants shifted attention left or right in response to their identity. Experiment 1 tested two predictions, derived from the transient and sustained response characteristics of the magnocellular and parvocellular inputs to the dorsal and ventral visual streams. These were, firstly that landmark cueing effects would remain robust under conditions of brief cue exposure time, and secondly that identity cueing effects would collapse when cue exposure time was reduced. Both predictions were confirmed. Experiment 2 tested two further predictions, derived from the varying contrast sensitivities of the magnocellular and parvocellular inputs to the dorsal and ventral visual streams: Firstly, that landmark cueing effects would remain robust when the luminance contrast of cues was low; and secondly that identity cueing effects would collapse under conditions of low cue luminance contrast. Again, both predictions were confirmed.

Conclusions: These results suggest that there may be a relatively direct link between visual input streams and mechanisms of attention shifting.

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### Effects of Low-Luminance Peripheral Landmarks on Eye Movements.

ANTHONY J. LAMBERT, LAURA-JANE BOOKER, *University of Auckland*.

Objectives: The specific prediction, based on physiological properties of the magnocellular inputs to the dorsal visual stream, that eye movements will be affected by rapid, non-conscious encoding of low-luminance peripheral landmark information was tested.

Methods: Participants fixated centrally, and then moved their eyes left or right to discriminate a peripheral (12.7 deg) target object. Low luminance (6.5 cd/m<sup>2</sup>) or very low luminance (2.1 cd/m<sup>2</sup>) landmark cues (X + T) were presented briefly (33ms) and bilaterally at the same eccentricity as the target, 66ms prior to its onset. The spatial arrangement of landmarks predicted target location ( $p = .8$ ),

but participants were not informed of this; a post-task questionnaire evaluated awareness of the relationship.

Results: Participants who remained unaware of the predictive utility of landmarks initiated saccades more rapidly when targets appeared at predicted, compared to non-predicted locations. A small number of anticipatory saccades, initiated in the brief interval after landmark onset but prior to target encoding, were observed. The direction of these saccades was biased towards the location predicted by landmark stimuli. In a second task, participants were able to discriminate consciously between the two possible spatial arrangements of landmark stimuli with high levels of accuracy.

Conclusions: (1) Eye movements can be influenced by rapid encoding of low luminance, peripheral landmark cues; (2) This encoding may be described as preconscious; (3) Preconscious encoding of peripheral landmark cues probably relies on the dorsal visual stream.

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### Implicit Semantic Expectancies Can Lead to Detection Costs (Dorsal Stream?) and Identification Benefits (Ventral Stream?).

JUAN LUPIÁÑEZ, *University of Granada*.

In the exogenous attentional orienting literature it has been shown that peripheral cueing can have opposite effects in detection and discrimination processes, and in RT vs. accuracy measures. Recently, we observed that not only incidental, non-predictive, spatial expectancies (as can spatial cueing be interpreted), but also implicit semantic expectancies can facilitate object identification at the same time they hinder object detection (LaPointe, Lupiáñez & Milliken, 2013). All this empirical evidence can be interpreted as if it is difficult for the system to realize that something is there (i.e. detection cost) precisely because it knows (i.e., has an implicit expectancy) that that thing is there (i.e., identification benefit). This pattern of results can be interpreted in neural terms on the basis of recent findings showing that object-specific neural preparation in V1 hinders object processing (i.e., better preparation in V1 leads to slower and less accurate object detection), whereas object-specific neural preparation in higher brain areas, such as Object Selective Cortex (OSC), facilitates object processing. That is, better preparation in OSC leads to faster and more accurate object detection (Peelen & Kastner, 2011).

LaPointe, M. R. P., Lupiáñez, J., & Milliken, B. (2013). Context congruency effects in change detection: Opposing effects on detection and identification. *Visual Cognition*, 21(1), 99-122. doi:10.1080/13506285.2013.787133

Peelen, M. V., & Kastner, S. (2011). A neural basis for real-world visual search in human occipitotemporal cortex. *Proc Natl Acad Sci U S A*, 108(29), 12125-12130. doi:10.1073/pnas.1101042108

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### Semantic and Syntactic Processing Along Selective and Nonselective Pathways.

MELISSA LE-HOA VÕ, *Goethe University Frankfurt*.

Objectives: When you look around, you will realize that our visual world is complex, but at the same time highly rule-governed. Objects in scenes, like words in sentences, seem constrained by a "grammar" that you understand implicitly and that allows you to process scenes efficiently. The sources that guide attention in real-world environments are manifold and interact in complex



ways. Contrary to arbitrary target objects placed in random arrays of distractors, objects in naturalistic scenes are placed in a very predictable manner. Thus, scene priors — i.e. expectations regarding what objects (scene semantics) are supposed to be where (scene syntax) within a scene — strongly guide attention.

Methods: I will show data from eye tracking and EEG experiments in which we presented participants with objects or words that did not fit the context of a scene either semantically or syntactically.

Results and Conclusions: The data show that scene perception is rapid, automatic, and obligatory with strong effects on both object and word processing. I will end by discussing the role of both the 'nonselective' pathway — in which information can be extracted in parallel from global and/or statistical information — and the 'selective' path — in which candidate objects must be individually selected for recognition — for the activation and execution of semantic as well as syntactic knowledge during scene search.

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### **Endogenous and Exogenous Orienting Mechanisms and Their Relation to Conscious Perception.**

ANA B. CHICA, *University of Granada*.

Objectives: Information can be selected via top-down or endogenous mechanisms, depending on the goals of the observers or the task at hand. Moreover, salient and potentially dangerous events also attract spatial attention via bottom-up or exogenous mechanisms, allowing a rapid and efficient reaction to unexpected but important events. The goal of this talk is to describe the modulation of conscious perception produced by endogenous and exogenous spatial orienting mechanisms.

Methods: I will present behavioral evidence emphasizing the differential characteristics of both attentional systems, with especial interest on the effects of endogenous and exogenous attention in conscious perception. Then, I will present new neurophysiological and neuroimaging data on the effects of both attentional systems on the conscious perception of near-threshold visual stimuli.

Results and Conclusions: Our results demonstrate that exogenous attention is an important pre-requisite of conscious perception, and the fronto-parietal network mediates its modulation of conscious perception. Endogenous attention can be dissociated and often does not modulate the conscious perception of near-threshold stimuli.

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### **Selective Attention for Biologically Relevant Information in Reel vs. Real Situations.**

ALAN KINGSTONE, *University of British Columbia*.

Objectives: In our everyday lives we are presented with more information than we can possibly take in. For this reason we continually have to select - overtly (by moving our eyes) or covertly (no eye movements) - what information we will act on, and what information we are going to discard and ignore. In the present talk three levels of research will be presented, with each level concerned with the selection of biologically relevant information (e.g., gaze selection).

Methods: At each level of investigation the endogenous (volitional) and exogenous (automatic) components that contribute to attentional selection of biological information are examined. At the first level, gaze selection is examined with natural static images (i.e., photos). At the second level, selection is investigated with dynamic images

(i.e., videos). At the third level, the stimuli are real people.

Results and Conclusions: The idea emerging from the present work is that the principles of attentional selection are molded by the context in which they operate. While there is a consistent preferential bias to select biological information, the factors that impact the endogenous and exogenous control of overt and covert attention change with the complexity and reality of the situation such that attentional performance at one level of complexity may not accurately predict performance at another.

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#### **DISCUSSANTS:**

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## **MACHADO ROOM, SATURDAY 7TH MAY, 8:40-10:00 SY17 The Confidence-Accuracy Relationship: New Analytic Methods Critically Amend Views of Eyewitness Identification Accuracy**

### **The Relationship between Confidence and Accuracy for Eyewitness Identifications Made From Simultaneous and Sequential Police Lineups.**

LAURA MICKES, *University of London*, JOHN T. WIXTED, *University of California*, JOHN C. DUNN, *The University of Adelaide*, STEVEN E. CLARK, *University of California*, WILLIAM WELLS, *Sam Houston State University*.

Eyewitnesses to a crime are often called upon by police investigators to identify a suspected perpetrator from a lineup procedure. Previous laboratory-based mock-crime studies have often been interpreted to mean that (a) confidence associated eyewitness identifications from a lineup procedure is an unreliable indicator of accuracy and (b) sequential lineup procedures are diagnostically superior to traditional simultaneous lineup procedures. Largely as a result, juries are often encouraged to discount eyewitness confidence, and up to 30% of law enforcement agencies in the U.S. have switched from using the simultaneous lineup procedure to using the sequential lineup procedure (Police Executive Research Forum, 2013). We conducted a field study of actual eyewitnesses ( $n = 348$ ) who were assigned to a simultaneous or sequential photo lineup procedure (administered in double-blind fashion) in the Robbery Division of the Houston Police Department over a one-year period. Identifications were made using a 3-point confidence scale (low, medium, or high confidence), and a signal-detection model was used to analyze and interpret the data. The results suggest that, contrary



to a widely held view that confidence and accuracy are only weakly related but in agreement with recent experimentally controlled mock-crime studies using a calibration approach, eyewitness confidence appears to be a highly reliable indicator of eyewitness accuracy. The results also suggest that, again contrary to a widely held view but in agreement with recent experimentally controlled mock-crime studies using receiver operating characteristic analysis, simultaneous lineup procedures are, if anything, diagnostically superior to sequential lineup procedures.

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### **The Confidence-Accuracy Relationship in Memory for Same-And Cross-Race Faces.**

KATHY PEZDEK, THAO B. NGUYEN, *Claremont Graduate University.*

Discrimination accuracy is reportedly higher for same- than cross-race faces, an effect known as the Cross-Race Effect. As such, race of face is considered an important estimator variable that affects eyewitness identification accuracy. However, Mickes (2015) has argued that discrimination accuracy for estimator variables is not informative to triers of fact because it does not provide forensically useful information to assess the trustworthiness of eyewitness identification. An examination of the Confidence-Accuracy Characteristic for estimator variables is more informative because it provides a posterior probability of guilt (i.e., probability that a suspect is guilty given that he was identified) at different levels of confidence. We analyzed datasets from four published recognition memory studies on same- and cross-race faces. Results indicate that confidence judgments made immediately following the initial identification reliably predict identification accuracy when performance (as measured by the posterior probability of guilt) is above chance levels (Studies 1, 2, and 3) but not when performance is below chance levels (Study 4). Furthermore, confidence-specific accuracy for same- and cross-race faces did not significantly differ at each level of confidence when overall performance was above chance levels (Studies 1, 2, and 3) but significantly differed when overall performance was below chance levels (Study 4). These results suggest that under certain conditions, a cross-race identification may be as trustworthy as a same-race identification, and more important, confidence at the initial identification may be a better indicator of accuracy than race.

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### **Using Lineup Instructions to Manipulate Response Bias and Its Relationship to Confidence-Based Rocs in Eyewitness Identification.**

STACY A. WETMORE, LAURA MICKES, *University of London*, JOHN T. WIXTED, *University of California.*

In the eyewitness identification literature, much attention has been paid to the instructions given to an eyewitness prior to a lineup procedure. In regard to signal detection theory, different instructions may induce different levels of response bias (Clark, 2005). If so, then collecting correct and false identification rates with different instructional conditions will trace out an ROC – the same ROC that, theoretically, could be traced out from a single instruction condition in which each decision is accompanied by a confidence rating. We tested whether the two approaches yield the same ROC. A large number of participants ( $n = 5,223$ ) were randomly assigned to either a confidence rating condition or an instructional condition

(liberal, neutral, unbiased, or conservative). After watching a video of a mock crime, participants were presented instructions followed by a simultaneous photo lineup. The ROCs from both methods were similar. These findings indicate that setting a higher or lower confidence criterion after the fact based on confidence ratings is conceptually equivalent to using instructions to induce more conservative or more liberal responding before the fact. Both strategies trace out the ROC, and in both cases, the diagnosticity ratio increases as responding becomes more conservative. Interestingly, the conservative biasing condition (participants were instructed not to make an ID unless they were 100% confident) yielded much more liberal responding than responses made with 100% confidence in the confidence rating condition, and as such, the diagnosticity ratio was higher in the latter condition (a forensically meaningful result for judges and jurors).

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### **Eyewitness Confidence: Perception and Accuracy.**

CHAD DODSON, *University of Virginia.*

Verbal expressions of confidence appear to be eyewitnesses' preferred way of expressing uncertainty. When an eyewitness identifies someone from a lineup and states, "I'm pretty sure it's him," how do we know that police, jurors and others will interpret this expression of confidence in the way that was intended by the eyewitness? Perhaps an eyewitness means she is only 50% sure but others might think she is 80% sure, or vice versa. I will address three questions in this talk: (1) To what degree do individuals interpret an eyewitness's verbal expression of confidence in the way that was intended by the eyewitness? (2) Are there variables that hinder or help another person's understanding of the intended meaning of an eyewitness's expression of confidence? (3) To what extent is eyewitness confidence an accurate predictor of identification accuracy? We have observed that individuals are most likely to misinterpret and underestimate the intended meaning of an eyewitness's expression of confidence when (a) an eyewitness is certain in her/his identification (e.g., "I'm positive it's him") and (b) the eyewitness justifies their level of confidence by referring to a visible feature about the suspect (e.g., "I remember his hair"). Yet, it is this combination of certainty that is based on an observable feature that is most predictive of eyewitness accuracy. These findings potentially have enormous implications for the legal system because perceived eyewitness confidence greatly influences jury decision-making and police investigations.

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PICASSO ROOM,  
SATURDAY 7TH MAY, 8:00-10:00  
**SY18 Domain-General and Domain-Specific Serial Order Mechanisms in Working Memory**

**Recalling Visual Serial Order for Verbal Sequences.**

ROBERT H. LOGIE, SAMARTH VARMA, *University of Edinburgh*, SATORU SAITO, *Kyoto University*, AIKO MORITA, *Hiroshima University*, DENNIS NORRIS, *MRC Cognition and Brain Sciences Unit Cambridge*.

We report two experiments in which participants performed written serial recall of visually presented verbal sequences with items varying in visual similarity. In Experiment 1 native speakers of Japanese recalled visually presented Japanese Kanji characters. In Experiment 2, native speakers of English recalled visually presented words. In both experiments, items varied in visual similarity and were controlled for phonological similarity. For Kanji and for English, performance on lists comprising visually similar items was overall poorer than for lists of visually distinct items across all serial positions. For mixed lists in which visually similar and visually distinct items alternated through the list, a clear 'zig-zag' pattern appeared with better recall of the visually distinct items than for visually similar items. This is the first time that this zig-zag pattern has been shown for manipulations of visual similarity in serial ordered recall. These data provide new evidence that retaining a sequence of visual codes relies on similar principles to those that govern the retention of a sequence of phonological codes. Together with previous evidence from healthy young adults (Logie et al., 2000; Saito et al., 2008), differential changes with age (Johnson et al., 2010) and domain-specific impairments in brain-damaged patients (reviewed in Logie et al., 2015), these results are interpreted as consistent with two domain-specific, limited capacity, temporary memory systems respectively for phonological material and for visual material, and each of which uses similar processes that have evolved to be optimal for retention of serial order.

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**Domain-Specific Interference in Serial Order Memory.**

ALEXANDER SOEMER, *University of Postdam*, SATORU SAITO, *Kyoto University*.

The nature of the cognitive processes underlying the short-term maintenance of serial order information has been intensively debated in recent years. One issue in this context concerns the potential existence of functionally specialized verbal and/or spatial order maintenance processes operating independently of domain-general order maintenance processes. Two experiments were carried out to address this issue using a concurrent serial reconstruction paradigm with one reconstruction task embedded within a second reconstruction task. In these experiments, two manipulations were carried out with the aim to find patterns of cross-set interference that potentially indicated the presence of functionally specialized order maintenance processes. Firstly, item set sizes were independently varied in the two tasks in order to compare the effects of increasing outer task and embedded task maintenance requirements on reconstruction performance in the embedded task. Secondly, in one condition the two sets of items were from the same domain

(verbal-verbal or spatial-spatial), while in a second condition they were from different domains (verbal-spatial or spatial-verbal). The results showed that while embedded reconstruction performance in the same-domain conditions was lower compared to the cross-domain conditions, there was no consistent evidence for effects of outer set size on embedded reconstruction performance in both the same-domain and cross-domain conditions. We discuss the implications of these results for domain-general and domain-specific views of serial order memory.

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**Perceptual-Motor Processing in Short-Term Memory and the Emergence of Domain Generality and Specificity.**

BILL MACKEN, DYLAN JONES, *Cardiff University*.

Theories of serial STM typically model performance utilising various ways of serially concatenating storage, maintenance and retrieval of a priori items (letters, digits, syllables, etc.). Questions of modality (e.g., auditory verbal versus visual verbal) in such accounts are typically dealt with via supplementary, item-oriented mechanisms involved with differential encoding processes or processing demands (e.g., obligatory versus deliberate), or different types of representational structure (e.g., relative distinctiveness of auditory versus visual verbal items). Here we question both these general assumptions involving the attribution of modality-specific effects to item-level factors, and the characterisation of performance in ostensibly order memory tasks as reflecting processes involved in the concatenation of a priori items. In a detailed analysis of the effect of modality, both on the shape of the serial position curve and on serial recall and serial recognition, we argue that modality plays a role in serial memory, not as the factor in itself, but rather as it modulates processes of object formation and how such object-formation processes afford to varying degrees performance in different types of ostensibly ordering tasks. We argue that domain generality of STM processes is due to the object-oriented-nature of perceptual processing regardless of modality, although the specific way in which perceptual objects are formed varies across modality. Domain generality also emerges in settings where motor control processes (e.g., articulatory, eye movements) may be utilised to reproduce sequential information, although the precise way in which they interact with perceptual processing also gives rise to modality-specific effects.

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**What Secondary Tasks Reveal about Immediate Serial Recall.**

IAN NEATH, AIMÉE M. SUPRENANT, ANDREW J. GABEL, CARI P. SEFFINGA, *Memorial University of Newfoundland*.

Immediate serial recall is affected by concurrent secondary tasks, but the specific pattern of disruption depends on the to-be-remembered items. For example, with no secondary task, short words are recalled in order more accurately than long words, but the short word advantage is reduced when presentation is accompanied by a secondary task such as concurrent articulation. In contrast, although high-frequency words are recalled in order more accurately than low-frequency words, the high frequency advantage is unaffected by concurrent articulation. In a series of studies, different classes of stimuli were categorized based on whether they interacted (e.g., word length, acoustic similarity, etc.) or did not interact (e.g., frequency, concreteness, etc.) with various secondary tasks. These



results are difficult for most models of immediate serial recall to explain, in large part because many accounts lack a way for long-term (or semantic) information to affect short-term performance. We discuss the results in the context of the Feature Model and explore the extent to which the following hypothesis is supported by the data: A stimulus class will interact with a secondary task on an immediate serial recall test when the items in the class are approximately equally easy to generate (e.g., 'T' vs. 'L') but will not interact when some items are easier to generate than others (e.g., high-frequency vs. low frequency words). We then show how this interpretation more readily supports a domain-general rather than a domain-specific serial order mechanism.

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### A Domain-General Model of Domain-Specific Effects in Working Memory.

KLAUS OBERAUER, *University of Zurich*, STEPHAN LEWANDOWSKY, *University of Bristol*, *University of Western Australia*, SIMON FARRELL, *University of Western Australia*, CHRISTOPHER JARROLD, *University of Bristol*.

Domain-specific dual-task costs in working-memory tasks have traditionally been taken as evidence for a fractionation of the working-memory system. I will present an alternative explanation based on representational interference, incorporated in a computational model, SOB-CS (Oberauer, Lewandowsky, Farrell, Jarrold, & Greaves, 2012). Interference between representations is a function of the overlap between the feature spaces of these representations, and of their similarity within a shared feature space. Verbal and non-verbal representations have at best partially overlapping feature spaces, so that there is little interference between them. Therefore, there is less interference between representations across domains than within domains.

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## MACHUCA ROOM, SATURDAY 7TH MAY , 8:20-10:00 SY19 The Adolescent Brain: Risky Behavior in Adolescence

### Cognitive Deficits as Risk Factors for Developing Eating Disorders during Adolescence.

REVITAL NAOR-ZIV, JOSEPH GLICKSOHN, *Bar-Ilan University*.

**Objectives:** Adolescents with eating disorders (ED) suffer from various neurocognitive impairments related to the functioning of the prefrontal lobes, including deficits in executive functions and 'theory of mind' (ToM) reasoning. Cognitive deficits can contribute to the development of ED, and to its maintenance over the lifespan. However, it is unclear whether these deficits indicate ED state or trait characteristics, making it problematic to draw conclusions about whether deficits in cognitive functioning represent endophenotypes for ED. **Methods:** We examined cognitive deficits contributing to the development of ED, distinguishing between adolescents at high risk and those not at risk for ED. A total of 150 participated in this study. We evaluated EF by means of the WCST, the IGT and the MFFT. In order to assess ToM, we used both the Faux Pas Test and

the Reading the Mind in The Eyes Test. **Results:** Impaired cognitive functioning that was most revealing pertained to the following: deficits in EF (especially in set shifting) and deficits in ToM. Furthermore, adolescents at high risk for bulimia were found to be higher in impulsivity and in ToM deficits, compared to adolescents at high risk for anorexia. Poor decision-making and poor ability to recognize basic feeling were not found to distinguish between adolescents at high risk and those not at risk for ED. **Conclusions:** Adolescents at high risk for development of ED have difficulties in comprehending complex social situations, and exhibit deficits in set-shifting ability, suggesting that these may be trait-vulnerability factors.

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### Development of Risk Taking, Perspective Taking, and Inhibitory Control during Adolescence.

GILLIAN HUMPHREY, IROISE DUMONTHEIL, *University of London*.

**Objectives:** Evidence from cognitive neuroscience conducted on distinct cohorts has suggested that uneven structural and functional brain development leads to discrete trajectories for cognitive, cognitive-emotional and social-cognitive development during adolescence. The aim of this study was to test the validity of trajectories inferred from distinct cohorts within a single sample of adolescents. **Methods:** Computerised measures of inhibitory control (Go-NoGo paradigm), emotional risk/reward processing (Balloon Analogue Risk Taking task), and social perspective-taking (Director task) were collected in a single testing session in 90 adolescents (aged 11-12; 14-15; and 16-18 years old). **Results:** Cross-sectional analyses revealed that inhibitory control matured first, with poorer performance in 11-12 year-olds than older adolescents. Social perspective taking matured later, with greater perspective-taking exhibited by the 16-18 year-olds than younger adolescents. The pattern was less clear for the risk/reward processing task, with a trend for older adolescent to show a greater propensity to take risk than 11-12 year-olds. We further observed that in 14-15 year-olds risk taking was associated with poorer NoGo accuracy and increased perspective taking was associated with faster Go reaction times, while NoGo accuracy predicted performance in the non-social condition of the Director task in 11-12 year-olds. Although our results are broadly consistent with previous findings obtained in distinct cohorts, we did not replicate a clear peak in risk taking during mid-adolescence. **Conclusions:** Our study further demonstrates that individual differences in inhibitory control differentially predict performance on complex tasks assessing emotional risk/reward processing and social cognition at different stages of adolescence.

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### Neural Activity Related to Response Inhibition at Age 14 Prospectively Predicts Transition to Regular Smoking at Age 18: A Longitudinal Study.

A.P. ANOKHIN, S. GOLOSHEYKIN, *Washington University School of Medicine*.

**Objectives:** Response inhibition deficits represent a major component of impulsivity and a risk factor for psychopathology characterized by poor impulse control, particularly addictive disorders. Correlations between response inhibition deficits, their neural correlates, and addiction have been reported, however, it



remains unclear whether such deficits represent the consequences of substance use or, conversely, risk factors that predate the onset of use. This “chicken-and-egg” problem can be resolved by prospective longitudinal studies. Here we investigated prospective developmental relationships between P3n and cigarette smoking in a large longitudinal cohort of adolescent twins. **Methods:** P3n was measured in No-Go trials of a cued Go-NoGo continuous performance task that required a speeded response to a particular combination of serially presented letters (O, X) and withholding the response to O, non-X (No-Go) combination. **Results:** Response inhibition in No-Go trials produced “anteriorization” of No-Go P300 component (P3n), a heritable neurophysiological marker of response inhibition. Longitudinal analyses have shown that reduced P3n amplitude at age 14 prospectively predicts transition to regular smoking (100+ cigarettes during lifetime) by age 18. Importantly, this association was specific to transition from experimentation to regular tobacco use, rather than onset of use. **Conclusions:** We conclude that abnormalities in the neurophysiological substrates of response inhibition represent a heritable developmental risk factor for future substance abuse.

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### Dealing with Uncertainty: Risk and Ambiguity Processing Across Development.

NEELTJE BLANKENSTEIN, EVELINE A. CRONE, ANNA C. VAN DUIJVENVOORDE, *Leiden University*, WOUTER VAN DEN BOS, *Max Planck Institute for Human Development*.

Adolescence is a period of pronounced neurodevelopmental change in both cognitive-control, social, and affective brain circuits that has been related to adolescent-specific changes in risky choice behavior and sensitivity to peer influence. Typically, to study adolescent risky choice, paradigms are used that involve gambles with known probabilities. In contrast, real-life risky choices often presents probabilities that are ambiguous (i.e., unknown). Adult studies have highlighted that taste for risk and taste for ambiguity may uniquely drive risk-taking behavior and developmental studies suggested that adolescent risk-taking may be particularly driven by a tolerance to ambiguity. Yet the development of risk- and ambiguity-attitude across adolescence, alongside the effects of social context, remains largely unstudied. **Methods:** The current study administered a choice task to a developmental sample ( $N=157$ , ages 10-25 years) that included both risky (known probabilities) and ambiguous (unknown probabilities) choices in both a solo and social context. We used a model-based approach to estimate and disentangle individuals' risk- and ambiguity-attitude in both contexts. **Results:** We observed a specific age-related change in ambiguity-attitude, in which younger adolescents were more ambiguity-tolerant. Moreover, a mediation-analysis revealed that age-related change in self-reported real-life risk taking was particularly driven by adolescents' ambiguity-attitude. Finally, the social context particularly influenced adolescents' risk-attitudes, in which participants overall were more risk-seeking in the social compared to the solo context. **Conclusions:** These results highlight the importance of studying and disentangling risk- and ambiguity- attitude to explain adolescent's risk taking behavior and are discussed vis-à-vis neural developmental trajectories in adolescence.

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### Relationships between Impulsivity, Anxiety, and Risk-Taking and Neural Correlates of Attention in Adolescents.

JAMES W. B. ELSEY, *Yale University School of Medicine, University of Amsterdam*, LESLIE K. JACOBSEN, *Bristol Meyers Squibb*, W. EINAR MENCL, CHERYL M. LACADIE, LINDA C. MAYES, *Yale University School of Medicine*, MARC N. POTENZA, *Yale University School of Medicine, Connecticut Mental Health Center*.

**Background:** Although impulsivity, anxiety, and risk-taking may relate to attentional processes, little research has investigated directly how each may be associated with specific facets of attentional processes and their underlying neural correlates. **Methods:** Nineteen adolescents underwent fMRI during a task involving simple and selective auditory attention, simple and selective visual attention, and divided attention across both modalities. Participants' scores on the Barratt Impulsiveness Scale 11<sup>th</sup> edition (BIS-11), Multidimensional Anxiety Scale for Children (MASC), and Balloon Analogue Risk Task (BART) were correlated with blood-oxygen-level-dependent (BOLD) response during each attention condition. **Results:** BIS-11, MASC and BART scores did not correlate with one another. BIS-11 scores were inversely associated with activation of striatal regions during visual selective and divided attention and dorsolateral prefrontal cortex activation during selective visual attention. MASC scores were positively associated with activation in visual processing regions during visual selective attention and negatively associated with activation in these regions and frontoparietal areas during divided attention. BART scores were positively associated with activation in orbitofrontal and striatal regions in auditory simple and selective attention and with activation in visual processing regions during auditory selective attention. **Conclusions:** Although impulsivity, anxiety and risk-taking have each been linked to adolescent risk behaviors, they represent dissociable constructs that are related to specific neural features underlying attentional processing. These preliminary findings suggest that specific interventions targeting these domains have the potential to work synergistically.

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### ANDALUCIA I & II ROOM, SATURDAY 7TH MAY, 11:00-12:40 SY20 Lexicon and Learning-Based Perspectives on Morphological Processing

#### “New” Quantitative Approaches to the “Old” Issue of Semantics in Morphological Processing.

SIMONA AMENTA, *University of Milan*, MARCO MARELLI, *University of Trento*.

The role of semantics in the early stages of word recognition has been extensively studied relying on masked priming experiments, with a limited success in providing converging data. Recently, new quantitative approaches allowed addressing the issue in an innovative and productive fashion, borrowing methods from computational modeling and distributional semantics. In this framework, we computed new measures that are intrinsically

semantic, as they take into consideration relationships among word meanings, and prove to be able to explain significant variations in traditional morphological masked priming studies over and above the simple factorial manipulation.

The Orthography-Semantics Consistency (hence, OSC) and the Intra-Semantics Consistency (hence ISC) are both semantic measures that capture the relationship between a word and the meaning of either its more frequent orthographic neighbors (OSC) or its closest semantic neighbors (ISC). Both measures were computed in a distributional semantic model and are successful in explaining data coming from unprimed visual word recognition (British Lexicon Project), morphological priming studies and semantic priming studies (from the Semantic Priming Project) (Amenta, Marelli and Crepaldi, 2015, a,b).

These measures are useful in individuating different activation networks in different priming paradigms, changing the research focus to “which type of semantics is involved in morphological processing?”

These measures represent an example of a broader effort to quantitatively define semantic features in complex word recognition, ranging from more general Semantic Density measures (Feldman, Marelli, Amenta and Milin, 2015) to estimates of semantic compositionality (Marelli and Baroni, 2015).

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### Entropy Effects in the Processing of Serbian Morphology.

DUŠICA FILIPOVIĆ ĐURĐEVIĆ, *University of Novi Sad, University of Belgrade*, ISIDORA GATARIĆ, *University of Novi Sad*, PETAR MILIN, *University of Novi Sad, Eberhard Karls Universität Tübingen*.

Numerous word recognition studies have revealed that Information Theory based measures of complexity predict processing latencies of various language phenomena. Within the domain of morphology, it has been demonstrated that noun processing is affected by the entropy of the probabilities of inflected forms in general (Inflectional Entropy; Tabak, Schreuder, & Baayen, 2005), as well as by divergence of the probability distribution of a particular noun’s paradigm from that of the noun class in general (Relative Entropy; Milin, Filipović Đurđević, & Moscoso del Prado Martín, 2009). The observed effects have been interpreted in terms of naive discriminant learning (Baayen, Milin, Filipović Đurđević, Hendrix, & Marrelli, 2011; Baayen & Ramscar, 2015). In this report we will continue this line of research by pursuing two goals. On the one hand, we will generalize relative entropy effects to other word categories and demonstrate how an entropy description of complexity can be modified to predict decision latencies to various word categories in Serbian. For example, we analyse whether that relative entropy effects can be observed in processing of words other than nouns that undergo nominal inflections, such as adjectives, and of morphologically complex words that do not undergo nominal inflections, such as verbs. On the other hand, we will demonstrate that entropy effects can be observed even in the processing of words that do not undergo inflection at all, but do play important role in resolving syntactic relations, such as prepositions. Taken together, by showing that entropy effects are present in both morphologically complex and morphologically simplex words, we will argue that cognitive system responds to complexity of the morphological system and not that of the surface form.

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### The Discrimination Learning Perspective on Morphological Segmentation: Valid or Void?

PETAR MILIN, *Eberhard Karls University Tübingen, University of Novi Sad*, R. HARALD BAAYEN, *Eberhard Karls University Tübingen, University of Alberta*, MICHAEL RAMSCAR, *Eberhard Karls University Tübingen*.

We discuss the plausibility of learning the connections between perceptual input cues and appropriate linguistic discriminations without explicit morphological analysis, using a computational model for lexical processing built on the Rescorla-Wagner network. To what extent can a model succeed recovering the lexical contrasts that are actually encoded in the orthographic signal, without initially (or ever) decomposing that signal into a non-overlapping sequence of words, stems, or affixes? To answer this question, we develop a naïve discriminative learning model that seeks to make use of the orthographic n-gram cues to discriminate those experiential contrasts that are encoded in verbal input stream. We then discuss a measure of prior availability that can be derived from the Rescorla-Wagner discrimination network, which correlates strongly with standard word frequency counts, and provides an explanation for the word frequency effects that does not assume “mental counters”. Finally, we demonstrate that the product of network prior availability and network activations (given perceptual input only) provides a single measure that predicts response latencies in primed lexical decision as compared far more parsimoniously than count based predictors.

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### Form Similarity and Morphological Complexity in Serbian–English Translation Equivalents.

JELENA RADANOVIĆ, *University of Novi Sad*, LAURIE BETH FELDMAN, *Haskins Laboratories, The University at Albany*, PETAR MILIN, *University of Novi Sad, Eberhard Karls Universität Tübingen*.

We investigated the role of graded form similarity and morphological complexity in the cognitive processing of Serbian–English translation equivalents. In the generalized lexical decision experiment we presented late Serbian–English bilinguals with four groups of translation equivalents that varied with respect to degree of form overlap: identical cognates (hotel–hotel), nonidentical cognates with Levenshtein distance (LD) = 1 (doktor–doctor), nonidentical cognates with LD = 2 (kristal–crystal) and noncognates (napor–effort). In order to manipulate morphological complexity each noun was presented in both singular and plural forms (doktor–doktori; doctor–doctors) to different participants. The results showed an interaction between form similarity and language, as well as main effect of morphological complexity. Serbian (L1) noncognates were processed faster than all groups of cognates, regardless of LD. On the other hand, in English (L2) identical cognates were processed faster than all other groups of nouns, i.e. nonidentical cognates and noncognates. With regards to the morphological complexity, singular forms were processed faster than plural forms and the effect did not interact with language (L1/L2). In a second experiment we manipulate the morphological structure of pseudowords to examine the role of stem lexicality moderates the form similarity by language interaction.

Results will be simulated with Naive Discriminative Models and discussed with respect to claims that differences between L1 and L2 processing are more reliable in the context of inflectional complexity.

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### **Morphological Structure in Native and Non-native Processing: Linguistic and Subject-Level Factors.**

JOÃO VERÍSSIMO, JANA REIFEGERSTE, and HARALD CLAHSSEN, *University of Potsdam*.

Whether native and non-native morphological processing employ the same mechanisms has been the subject of considerable debate. Some studies show similar effects in L1 and L2 groups, while others suggest that certain morphological operations might be selectively unavailable in non-native processing.

We review a number of morphological priming studies and ask whether linguistic (inflected- derived; regular-irregular forms) and subject-level factors (acquisition-chronological age) modulate morphological priming in native and non-native populations.

The results from a quantitative meta-analysis of L2 morphological priming indicate that facilitation from derived forms is robust and of comparable magnitude in L1 and L2 groups, but inflectional priming effects are considerably smaller in a non-native language. In two further studies, we also show that L1-L2 differences interact with both age of acquisition and with chronological age. Participants who acquired an L2 before age 6 show priming for all complex forms, whilst for late learners, age of acquisition reduces inflectional, but not derivational priming. Furthermore, aging plays a selective role in that priming from irregular inflection decreases for older native and non-native speakers.

We interpret these results in terms of an architecture that distinguishes between lexical storage and grammatical computation. Morphological operations that create new lexical entries, like derivation, are part of the L2 mental grammar and can be applied in the processing of complex words. In contrast, paradigmatic mappings that express grammatical features (i.e., inflection) need to be stored in lexical memory by late learners. Finally, irregular inflection, which is lexically-based in both L1 and L2 processing, is susceptible to age-related decline.

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MACHUCA ROOM,  
SATURDAY 7TH MAY, 11:00-12:40

## **SY21 Research on Arithmetic Fact Learning: Evidence from Healthy and Impaired Participants**

### **Serial-Order Learning Impairment and Hypersensitivity-to-Interference in Dyscalculia.**

ALICE DE VISSCHER, ARNAUD SZMALEC, LIZE VAN DER LINDEN, MARIE-PASCALE NOËL, *Université Catholique de Louvain*.

Objectives:

In the context of heterogeneity, the different profiles of dyscalculia are still hypothetical. This study aims at linking features of mathematical difficulties to certain potential etiologies. First, we wanted to test the hypothesis of a serial-order learning deficit in dyscalculia. Second, we wanted to disentangle it from a recent hypothesis according to which hypersensitivity-to-interference hampers the storage of arithmetic facts and leads to a particular profile of dyscalculia.

Methods:

For this purpose we tested adults with dyscalculia and used a

Hebb repetition learning task with interfering and non-interfering repeated sequences. In addition, we tested the memory trace of the non-interfering sequence and the capacity to manipulate it.

Results:

In line with our predictions, we observed two different profiles of dyscalculia. On the one hand, people with dyscalculia who showed a deficit in a global mathematical test suffered from a serial-order learning deficit characterized by a slow learning and a quick degradation of the memory trace of the repeated sequence. On the other hand, people with dyscalculia who showed good conceptual knowledge in mathematics but impaired arithmetic fluency suffered from increased sensitivity-to-interference compared to controls.

Conclusions:

This study provides new evidence and refinement for two particular profiles of dyscalculia. One profile with global math impairment is related to a serial-order learning impairment. Since serial-order learning is necessary for the number-word sequence acquisition, we interpret that a deficit at this level could explain a basic numerical deficit. Conversely, the profile of dyscalculia characterized by a circumscribed arithmetic fluency deficit in dyscalculia is related to hypersensitivity to interference in memory.

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### **The Coactivation and Selection of Simple Arithmetic Facts: Electrophysiological Evidence.**

PATRICIA MEGÍAS, *University of Granada*, PEDRO MACIZO, *University of Granada*, Mind, Brain and Behavior Research Center, BELÉN ARANDA, *University of Granada*.

Objective:

The objective of the current study was two-fold. We aimed at determining the electrophysiological correlates associated to the coactivation of arithmetic facts and the possible inhibitory mechanism responsible to select the correct one.

Methods:

To this end, simple additions were presented in blocks of two trials and participants had to decide whether they were correct or not. We evaluated the N400 component as an index of the competition between arithmetic facts; and the P200 component, which reflects the difficulty in the retrieval of arithmetic facts.

Results: When an addition was incorrect but the result was that of multiplying the operands (e.g.,  $2 + 4 = 8$ ), the N400 amplitude was more negative compared to a control condition (e.g.,  $2 + 4 = 10$ ). Moreover, the P200 amplitude was more positive when an addition whose result was that of multiplying the operands of the previous trial was presented (e.g.,  $2 + 6 = 8$ , preceded by  $2 + 4$ ) compared to a control condition (e.g.,  $4 + 6 = 10$ , preceded by  $2 + 4$ ).

Conclusions: Our findings supported the coactivation of irrelevant multiplication facts when participants resolved addition problems. Additionally, the results suggest that those inhibited results in the first trials were more difficult to retrieve from long-term memory afterwards.

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### Individual Differences in Arithmetic Fluency.

JAVIER GARCÍA-ORZA, JOSÉ MIGUEL RODRÍGUEZ, MARINA CALLEJA, MAURICIO IZA, JUAN ANTONIO ÁLVAREZ, *Universidad de Málaga*.

#### Objectives:

Classical views of dyscalculia consider that a deficit in number representations or in the access to number meaning from symbolic representations may play a causal role in the appearance of deficits in arithmetical fact retrieval. However, recently it has been suggested that hypersensitivity to interference may explain pathological (and normal) differences in arithmetical fluency tasks. In this study we tested the above mentioned hypotheses.

#### Methods:

Seventeen low arithmetic fluency adults and 17 high arithmetic fluency adults were evaluated in a short term memory serial recall test with similar and dissimilar sequences to evaluate sensitivity to (phonological) interference. They also completed a numerical matching task with arrays of dots or with a mixed notation (Arabic numbers and dots). Three ratios and trials with perceptual cues that can be congruent or incongruent with numeracy were employed to explore numerical representations and their access from symbolic representations. Groups did not differ in CI or in general processing speed.

#### Results:

In the memory task no differences were found in the size of the phonological similarity effect between both groups, suggesting similar sensitivity to interference. High arithmetic fluency participants took advantage of perceptual cues to solve the matching task with dots, however, low arithmetic fluency participants did not benefit from congruent trials.

#### Conclusions:

The similar pattern in the memory task goes against the hypersensitivity to interference account. The finding of differences in the matching task suggests that deficits in numerical processing may impact on the building of a network of arithmetical facts.

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### Number Sense in Children with Learning Disabilities.

AVITAL ROTEM, *Ben-Gurion University of the Negev, Achva Academic College*, AVISHAI HENIK, *Ben-Gurion University of the Negev*.

#### Objectives:

Mathematics education today emphasizes developing number sense, without ignoring simple arithmetic. With age and practice, typical achieving (TA) children form an arithmetical network and retrieve the results to most single-digit problems (i.e., arithmetic facts), from memory. Children with mathematics learning disabilities (MLD) struggle with arithmetic facts, despite multiple practices. We studied the multiplication and multiplication number sense development in TA and MLD children.

#### Methods:

TA 2<sup>nd</sup>, 4<sup>th</sup>, and 6<sup>th</sup> graders and adults and 6<sup>th</sup> and 8<sup>th</sup> graders with MLD participated in three product verification experiments.

#### Results:

Accuracy and speed of 6<sup>th</sup> graders with MLD were similar to those of 2<sup>nd</sup> TA children. Eighth graders with MLD improved, but only on easy problems (i.e., problems with two operands  $\leq 5$  or two equal operands). Their improvement was limited to the speed and accuracy levels seen in TA 4<sup>th</sup> graders. Moreover, in the easy problems only, 8<sup>th</sup> graders with MLD developed multiplication

number sense with similar characteristics to that of TA 4<sup>th</sup> graders. Namely, they were: (a) sensitive to results' distance from the true result and to their relatedness to multiplication rows; (b) they have just started to be sensitive to products parity, mainly on even X even problems; and (c) they were not yet sensitive to whether the decade digit of results was identical to the true result ("Interacting Neighbors").

#### Conclusion:

Children with MLD develop an arithmetic network, though late, weak and partial, similar in characteristics to TA's network. We argue that developing arithmetic network and number sense are mutually related.

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### ERPs Reveal a Preferred Code for Complex Calculation in Proficient Bilinguals.

ELENA SALILLAS, *Basque Center on Cognition, Brain and Language*.

#### Objectives:

One of the languages might have preferential access to the math system in bilinguals. However, the extent to which this language preference is established in proficient bilinguals and the specifics of such preference need to be further explored.

#### Methods:

In this study, by measuring ERPs while proficient bilinguals solved incremental addition with differing solution sizes, we inferred underlying solving processes that differed for each auditory input language. The ERP 'problem size effect' reflected in a negative slow wave (nSW) was used as the dependent variable to determine the quality of those calculation processes.

#### Results:

This nSW was modulated by problem size in both languages, reflecting an increase in the workload and use of procedural strategies as the solution size increased. However, when the input was in the preferred language, only the largest problems sizes implied a higher cognitive effort, reflected by a larger nSW. Medium problem sizes modulated this component only when the input was in the non-preferred language and the time course of the nSW differed between the two languages. Behavioral error analysis paralleled the ERP results, ruling out an explanation in terms of translation processes. Crucially, this preferred language for complex calculation was determined during early learning and not by proficiency or general language use.

#### Conclusions:

Our data suggests that the same arithmetic problem is solved by retrieval in the language of early math education but might need of procedural strategies when presented in the non-preferred language even for very proficient bilinguals.

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ALBENIZ ROOM,  
SATURDAY 7TH MAY, 11:00-12:40  
**SY22 Linking Basic and Applied  
Science: The Case of the Differential  
Outcomes Effect**

**The Neurobiological Underpinnings of the Differential Outcomes Effect.**

LISA M. SAVAGE, *University of Binghamton*.

**Objectives:** Altering the types of association an organism can use to solve memory problems can lead to enhancement of learning and memory. Furthermore, such manipulations can utilize neural circuits that are not comprised in aging or amnesia, leading to recovered memory performance.

**Methods:** Intact and neural compromised (aged, amnesic and lesioned) rodents were trained to learn and remember spatial locations. Some rats were trained with the Differential Outcomes Procedure (DOP), in which to-be-remember cues were associated with unique reward outcome. This manipulation leads to the development of unique reward expectations. For comparison, other rats were trained with a Nondifferential Outcomes Procedure (NOP), in which cues and rewards were not associated.

**Results:** The implementation of unique cue-reward associations (DOP), over the use of non-associated cue and reward (NOP), led to better learning and memory in aged and amnesic rats. Lesion studies suggest that lateral amygdala and the orbital frontal cortex are important for establishment and maintenance, respectively, of unique cue-reward associations.

**Conclusions:** These results demonstrate that training unique cue-reward associations can prompt reward-related neural circuits that lead to improved behavioral success. Manipulation of cue-reward associations is an effective procedure to enhance both learning and retention of information, even in the face of deterioration or damage to the brain.

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**Neural Dynamic Modelling of the Associative Two-Process in Differential Outcomes Training.**

ROBERT LOWE, *University of Skövde*.

**Objectives:** To neural-dynamically realize the Associative Two-Process (ATP) in order to shed light on the nature of the interaction of the so-called retrospective (S-R) and prospective (S-E-R) processing routes. The prospective route facilitates or overshadows retrospective response control under Pavlovian-Instrumental Transfer (PIT) conditions, depending on the outcome histories. We wish to shed light on how this is neural-dynamically instantiated. **Methods:** We examine our objectives according to the spatial precision hypothesis of development using empirical data. Our neural-dynamic model, which we call the Actor Differential Outcomes Critic, or simply Actor DO-Critic, is consistent with a connectionist framework that incorporates reinforcement learning and neural field theory. The model also captures data from established animal learning paradigms.

**Results:** The Actor DO-Critic qualitatively reproduces the above-mentioned empirical data. We have previously reported first results but here we present results showing the spatial precision hypothesis can explain the development of differential outcomes versus non-

differential outcomes learning performance over ages between 4 and 8.5 years. The model is also able to generate facilitation and overshadowing in PIT conditions as a function of working memory development.

**Conclusion:** ATP theory can be modelled in a way that captures key phenomena associated with differential outcomes learning, e.g. development and facilitation/overshadowing. From a neural-computational perspective our model predicts neurons encoding for omission and relative omission prediction provide a value-based means to classify differential outcomes.

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**Contribution of Differential Outcomes Procedure on Learning and Memory.**

L. REBECA MATEOS MORFIN, CARLOS J. FLORES AGUIRRE, *Universidad de Guadalajara*.

**Objectives:** The purpose of the work is to show some findings obtained in our laboratory about the contribution of differential outcomes procedures (DOP) on learning and memory in rats and humans.

**Methods:** In the first study, we evaluated the contribution of using a DOP in young and aged rats. In a second work, using different probabilities of reinforcement as differential outcomes procedures (DOP), we evaluated the effect of resistance to change by increasing the delay interval. In both experiments, a standard two-choice discrimination task was used. Finally, in a third study, we evaluated the generality of the differential outcomes effect using sensory outcomes (visual and auditory) in a many-to-one matching to sample task.

**Results:** In the first study we observed that the rats trained with a DOP – young or aged – learned more quickly than the subjects trained with a non-differential procedure. In the second experiment we observed the typical result of using a DOP, but we did not find the resistance to change effect. In the third study the participants with DOP showed a higher accuracy and a faster acquisition in contrast to subjects with no differential outcomes. **Conclusion:** As a whole, these results confirm that employing DOP is an effective training strategy that can favor both speed of acquisition and enhance memory in rats and humans.

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**Spatial Working Memory Is Enhanced by the Differential Outcome Procedure in Patients with Either Mild Cognitive Impairment or Alzheimer's Disease.**

ANA B. VIVAS, ANTONIA YPSILANTI, ARISTEA I. LADA, *The University of Sheffield International Faculty, Thessaloniki*, ANGELES F. ESTEVEZ, *Universidad de Almeria*.

**Objectives:** Mild Cognitive Impairment (MCI) is considered an intermediate stage between normal and pathological aging, as a substantial percentage of people diagnosed with MCI converts later to dementia of the Alzheimer's type (AD). Memory is one of the first cognitive processes to deteriorate in this condition as well as in AD. In the present study we aimed to explore whether the differential outcomes procedure (DOP) would improve spatial recognition memory in adults diagnosed with MCI or AD.

**Methods:** A group of 24 patients with MCI or AD had to learn and keep in working memory four target locations out of eight possible locations where a shape could be presented. In the differential outcomes condition each target location was paired with a specific

outcome; whereas in the non-differential condition outcomes were administered randomly.

Results: Participants in both groups show a statistically significant better terminal accuracy when a unique outcome was paired with each location as compared to the control condition. Conclusion: This finding suggests that the DOP is useful in improving working memory in MCI patients, which may delay their conversion to dementia. The results obtained with the AD patients also indicate that this procedure can be an effective technique to facilitate working memory-based performance especially in those people with memory impairments.

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### Enhancing Adherence to Treatment by Differential Outcomes: A Simulated Study with Healthy Adults.

VICTORIA PLAZA, *Universidad Autónoma de Chile*, MICHAEL MOLINA, *Universidad de Almería*, LUIS J. FUENTES, *Universidad de Murcia*, ANGELES, F. ESTEVEZ, *Universidad de Almería*.

Objectives: Adherence to treatment, that is, the degree to which patients follow the medical recommendations related mainly, but not exclusively, to medication, is fundamental to improve health and quality of life in the general population. Lack of adherence to treatment may have dramatic consequences not only for health but also for economy. In the present study we conducted a simulated study to test the utility of a procedure (the differential outcomes procedure, DOP) that may improve adherence to treatment by increasing patient's learning and retention of medical recommendations regarding medication. The DOP requires the structure of a conditional discriminative learning task in which correct choice responses to specific stimulus-stimulus associations are reinforced with a particular reinforcer or outcome.

Methods: To simulate the memory burden that taking several drugs may impose in a multiple morbidity situation, we ran two experiments in which young participants were "prescribed" a treatment that required taking 6 different drugs. To assess the long-term effects of the DOP, participants were also tested 1 hour and 1 week after completion of the learning phase. Results: The results showed that compared with the standard non-differential outcomes procedure (NOP), the DOP produced better learning and long-term retention of the previously learned associations.

Conclusion: These findings suggest that the DOP can be used as a useful complementary technique in intervention programs targeted to increase adherence to medical recommendations. The ecological nature of the symbolic discrimination task used in the present study, allows us to highlight the therapeutic potential of the DOP as a complementary strategy for people with learning and memory deficits (e.g., those with neurodegenerative disorders associated with aging such as patients with Alzheimer's or Parkinson's disease), which seriously affect their daily life.

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## FALLA ROOM, SATURDAY 7TH MAY, 15:40-17:00 SY23 Linguistics Cues and Social Behavior

### How Direct and Indirect Speech Impact Language Comprehension.

ROLF A. ZWAAN, *Erasmus University Rotterdam*, ANITA EERLAND, *Utrecht University*, JAN A.A. ENGELN, *Tilburg University*.

Language can be viewed as a set of cues that modulate the comprehender's thought processes. Earlier research suggests that people perceive direct speech (e.g., Joanne said: "I went out for dinner last night") as more vivid and perceptually engaging than indirect speech (e.g., Joanne said that she went out for dinner last night).

Our participants read short stories or sentences online and then performed a probe recognition task (either with written or spoken probes). In the last experiment, participants did not perform a probe recognition task but a memory task to test for effects of direct and indirect speech on the surface representation level.

Our results do not support the idea that, compared to indirect speech, direct speech enhances the accessibility of information from the communicative or the referential situation during comprehension. Neither do our results support the idea that the hypothesized more vivid experience of direct speech is caused by a switch from the visual to the auditory modality. However, our results do show that direct speech leads to a stronger mental representation of the exact wording of a sentence than does indirect speech.

We will discuss the implications of these findings for theories of situation model construction in language comprehension.

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### Aspectual Framing.

TEENIE MATLOCK, *University of California, Merced*.

Aspect is, has been, and will continue to be part of language as long as humans communicate. The goal of this talk is to discuss data from various experiments on the use and understanding of aspect in everyday English. Of special interest will be differences that arise in the perception of actions and states with past progressive (was VERB+ing) versus simple past (VERB+ed), as in Ed was walking to school last night versus Ed walked to school last night. Data from various studies—using different methods—will be presented. Some work involves the use of surveys. Other work involves the collection of and analysis of natural discourse. The work is part of a larger project on framing in both literal and non-literal language.

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### The Influence of Verb Aspect and Visual Perspective on Imagining Events.

TODD R. FERRETTI, JEFFREY P. HONG, DEANNA C. HALL, JAMES SIKLOS-WHILLANS, *Wilfrid Laurier University*.

This research examined how grammatical and lexical aspect influence the ability to imagine events. Another objective was to examine how imagining from different visual perspectives (first vs. third person) interacts with the temporal properties of the



imagined events. We expected events to be easier to imagine when grammatical and lexical aspect match temporally (i.e., imperfective activities, perfect accomplishments), and that imagining from a first person perspective may be easier when the imagined events have an inherent ongoing nature (i.e., activities).

Participants were presented with event cues containing accomplishments (e.g., I was building) or activities (I was acting) referenced as either ongoing or completed. Participants were cued to take a specific visual perspective or not, and were required to imagine the events for five seconds. Slow cortical brain potentials were examined to index the ease of imagining events, and participants answered questions regarding the content of the imagined events.

Results demonstrated that events were easier to imagine when grammatical and lexical aspect matched temporally. Visual perspective also influenced the ease of imagining events differently for activities (easier with first person perspective) and accomplishments (easier with third person perspective). These perspective differences were found for both ongoing and completed events. Our behavioral data also demonstrated that grammatical aspect and visual perspective influenced the vividness of the imagined events.

These results provide novel insight into how people mentally represent events by showing how temporal information associated with verbs and visual perspective interacts to constrain the ability to imagine events.

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### Understanding How Grammatical Aspect Influences Legal Judgment.

ANITA EERLAND, *Utrecht University*; ANDREW M. SHERRILL, *Northern Illinois University*; ROLF A. ZWAAN, *Erasmus University Rotterdam*; JOSEPH P. MAGLIANO, *Northern Illinois University*.

Recent evidence suggests that grammatical aspect can bias how individuals perceive criminal intentionality during discourse comprehension. Given that criminal intentionality is a common criterion for legal definitions (e.g., first-degree murder), the present study explored whether the influence of grammatical aspect may impact court decisions.

In our experiments participants were provided with a legal definition and a description of a crime in which the grammatical aspect of provocation and murder events were manipulated. Participants were asked to commit a decision (first- vs. second-degree murder) and then indicate factors that impacted their decision.

Findings suggest that legal decisions can be affected by grammatical aspect but the most robust effects were limited to temporal dynamics, which may in turn influence other representational systems. In addition, findings demonstrate that the influence of grammatical aspect on situation model construction and evaluation is dependent upon a larger linguistic and semantic context.

Together, the results suggest grammatical aspect has indirect influences on legal judgments to the extent that variability in aspect changes the features of the situation model that align with criteria for making legal judgments.

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## MACHUCA ROOM, SATURDAY 7TH MAY, 15:00-17:00 SY24 Open Issues in Perceptual Organization

### More Than Mere Association: Mechanistic Relationships between Perceptual Grouping and Figure-Ground Organization.

JOSEPH L. BROOKS, *University of Kent*.

Perceptual grouping and figure-ground organization are classic topics in perceptual psychology and, although they are often discussed together (and sometimes confused) as Gestalt topics, there has been little in the way of mechanistic relationships between them. In fact, they often describe very different phenomena. Grouping describes associations between already-segmented and shaped elements whereas figure-ground organization is meant to be a process by which shape and depth is determined. Here, I will describe work which demonstrates interactions between these two visual processes. First, our results show that factors which provide a basis for grouping between edges and regions can significantly affect figure-ground organization. We call this edge-region grouping and can use it to coherently explain a variety of new, and previously known, figure-ground cues/factors. Additionally, using both behavioural and neuropsychological evidence we show that grouping can be critical for the propagation of figure-ground information from one part of a scene to another. Thus grouping is a mechanism by which figure-ground organization can be affected by global factors and moderate and contextualize local information. Overall, this work shows that grouping and figure-ground organization are more than mere siblings within Gestalt psychology. Instead, perceptual grouping provides important mechanisms for incorporating global information into figure-ground processes and can provide a basis for explaining a range of figure-ground phenomena under a coherent framework.

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### Varieties of Part-Whole Relationships and the Theory of Basic Gestalts.

JAMES R. POMERANTZ, *Rice University Houston*.

With some configurations, the arrangement of the parts seems to largely determine the whole (Asch's hierarchical patterns) whereas with others we find the opposite, where the whole dictates the parts (Duncker's wheel; Dalmatian dog; parenthesis pairs; arrows and triangles). In some configurations, swapping out the parts for an alternate set of parts changes the whole whereas in others it does not. Here I attempt to revive a distinction between two types of configurations, Type P and Type N, where Type N conforms more closely to our notion of a Gestalt in yielding configural superiority, Garner Interference, steeply negative search slopes, false pop out and displaced pop out where, in a field of items that are all identical except for one, Ss predictably point to a region of empty space between two items when asked where the disparity in the display is located. These ideas will be connected conceptually with emergent features and the Theory of Basic Gestalts. I conclude that theories that ignore Gestalt principles will misconstrue the basic units from which percepts are constructed and so will fail to explain many of the most important and central phenomena in perception.

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### The Role of Perceptual Organization in Crowding.

RUTH KIMCHI, *University of Haifa*.

Identification of a peripheral target in the presence of nearby flankers is worse than when the target appears alone – a phenomenon known as crowding. Prevailing theories hold that crowding occurs because of integration or “pooling” of low-level features at a single, relatively early stage of visual processing. We examined whether crowding can occur at multiple levels, namely, at the object level in addition to the feature/part level. In several studies we measured target (a global, disconnected configuration made of elements) identification at varying eccentricities. The flankers that surrounded the target were similar either to the target parts or to the target configuration, and degree of feature similarity was controlled for. The results show both crowding by parts and crowding by configurations. The strength of crowding by parts or configurations is dependent on the strength of the target’s organization – the stronger is the target’s organization the less likely it is to be crowded by flankers similar to its parts relative to flankers similar to its configuration. These results provide strong evidence that crowding occurs not only between object parts but also between configural representations of objects, and demonstrate the role of perceptual organization not only in crowding, but in vision in general.

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### Hierarchical Organization.

WALTER GERBINO, *University of Trieste*.

Notions like hierarchical structure, frame of reference, and separation of systems imply that perceptual organization involves an asymmetric relationship between the whole and its parts: parts depend on the whole more than vice versa. Hierarchical organization has been invoked to explain aspects of perceptual phenomena distributed over several domains: orientation, motion, achromatic and chromatic surface color. However, compared to grouping principles that predict belongingness (a symmetric part-part relationship) and whose validity is widely recognized, the principles subtending the effects of becoming part of a whole are still controversial. In this respect, a special role is played by phenomena not explained by spatial inclusion, which is frequently mentioned as an overarching principle of hierarchical organization.

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### The Role of Perceptual Organization in the Leuven Embedded Figures Test (L-EFT).

JOHAN WAGEMANS, *KU Leuven (University of Leuven)*.

Our visual system prioritizes global structures above local elements (Navon, 1977). A myriad of tasks claim to dissociate global from local perception, but the constructs underlying these tasks remain unclear. One paradigm commonly used in this field is the Embedded Figures Test (EFT; Witkin, Ottman, Raskin & Karp, 1971) but its results have been prone to a wide variety of interpretations. The current study, testing large samples of participants, was aimed at a better understanding of what is measured by the EFT. Therefore, the Leuven EFT (L-EFT) was designed where perceptual organization factors at the local target level (e.g., symmetry or closure), and at the global pattern level (e.g., number of lines continuing from target into context) were independently manipulated in order to

dissociate local from global processing. Secondly, the association between L-EFT performance, non-verbal intelligence and several executive functions was assessed to evaluate the impact of both perceptual and cognitive aspects on L-EFT performance. These data can clarify the construct validity of this paradigmatic task of global/local processing. In addition, the L-EFT may offer a more controlled measure, which is better able to differentiate between contributions of genuine perceptual organization, as opposed to executive function to EFT performance.

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### On The Edge of a Modal Completion.

ROB VAN LIER, *Radboud University Nijmegen*.

A crucial aspect of perceptual organization concerns the filling-in of missing parts. During the process of figure-ground segregation, parts of the ‘ground’ are unseen – yet perceptually present. Here we enter the domain of what has been referred to as ‘amodal completion’ or ‘amodal presence’. The awareness of unseen parts triggers the question whether these parts are the result of a mere perceptual process or whether knowledge-based inferences play a role as well. Despite the adjective ‘amodal’ some typical extrapolations are often thought to be ‘genuine perceptual’ (collinearity, symmetry) whereas others are thought to be of a more cognitive nature (familiarity, and again symmetry). This is a rather odd situation. With regard to, for example, symmetry a literature survey reveals strongly diverging opinions. Defining a clear segregation between perception and cognition, however, appears to be a hazardous enterprise, certainly so at the brain level. By means of various demonstrations I will argue that amodal completion is an intriguing, but somewhat neglected, entrance to further explore the alleged border – or grey zone – between perception and cognition. I will further argue that ultimately a strict distinction might be untenable.

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FALLA ROOM,  
SATURDAY 7TH MAY, 17:00-19:00

## SY25 Cognitive Control and Language Processing in Bilinguals and Monolinguals

### Cognitive Control and Language Processing: Evidence for a Causal Connection.

JARED M. NOVICK, NINA HSU, *University of Maryland, College Park*, ERIKA HUSSEY, *University of Illinois, Urbana-Champaign*, SUSAN TEUBNER-RHODES, *Medical University of South Carolina*, IRENE P. KAN, *Villanova University*.

Speech unfolds swiftly, yet listeners keep pace with their conversational partner by rapidly assigning meaning to what they hear. Similarly, readers interpret text incrementally as their eyes move across a page, rather than waiting until they come to a period at the end of a sentence. Though efficient, real-time language processing can be costly because early interpretations sometimes turn out wrong. How do readers and listeners immediately revise misinterpretations before language processing reaches a bottleneck? Cognitive control may play a role by detecting when comprehension has gone awry, and then initiating behavioural adjustments to resolve conflicting interpretations. However, most





of the evidence for this is correlational. Does cognitive control actually *cause* revision to be fairly unproblematic? We discuss a research program addressing this causal issue. First, in two studies, we demonstrate that longitudinal training of cognitive control procedures reliably predicts better sentence re-interpretation over time. This finding suggests that aspects of cognitive control may be plastic, conferring relevant benefits to language processing. However, these training-induced performance changes do not address whether *dynamic* cognitive control engagement intrinsically facilitates people's ability to override erroneous interpretations moment-by-moment. We also discuss evidence that readers' discovery of a misinterpretation results in attenuated Stroop-conflict effects on the next trial, suggesting that comprehension difficulty rapidly recruits cognitive control. Similarly, Stroop-conflict detection, which recruits cognitive control, subsequently facilitates listeners' incremental processing of temporarily ambiguous spoken instructions that induce brief misinterpretation. We conclude then that cognitive control engagement *accelerates* sentence re-interpretation processes, even as linguistic input is still unfolding.

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### Unexpected Non-target-language Cues Reveal Language-Cognition Links in Spanish-English Bilingual Listeners.

HENRIKE K. BLUMENFELD, *San Diego State University*, MARCEL R. GIEZEN, *Basque Center on Cognition, Brain and Language*, SHIRLENE WADE, *University of Rochester*.

Bilinguals are sensitive to language-specific cues in voice-onset-time (VOT) and to similarity of translation equivalents (cognate status). We examined whether these acoustic and lexical cues exert separable influences on English auditory word identification in bilinguals and whether these effects are related to bilinguals' ability to inhibit irrelevant stimulus dimensions. Proficient Spanish-English bilinguals listened to English words and identified corresponding referents from a computer-presented display containing four objects. Stimuli included cognate targets (*peak-pico*) and noncognate targets (*peel-cascara*) that started with voiceless stops. On half of these targets, participants heard words where voice-onset-times had been shortened to resemble VOTs typical of Spanish words. Participants also completed a non-linguistic Stroop task (e.g., response to a right-pointing arrow presented on the left would require inhibition of location). Preliminary findings yielded an interaction between cognate status and voice onset time,  $F(1,22)=7.6, p=.01$ . For cognates, bilinguals responded equally fast and accurately to English words with English-like and Spanish-like VOTs. For noncognates, bilinguals were slower responding to English words with Spanish VOTs. When word identification latencies in each linguistic condition were correlated with bilinguals' Stroop performance, a significant correlation only emerged with the noncognate/Spanish VOT condition: participants with smaller Stroop effects showed *slower* responses in this condition ( $r=-.48$ ). We conclude that acoustic and lexical cues exert independent influences on bilinguals' spoken word identification. Further, bilinguals with better inhibition skills may experience greater slowing when they encounter unexpected cross-linguistic cues during language-specific listening, perhaps because they more routinely inhibit non-target language representations in these contexts.

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### Cognitive Control and Pronoun Use in Late Bilinguals.

ANTONELLA SORACE, *University of Edinburgh*.

The use of pronouns, like reference tracking in general, requires the language user to both infer appropriate pronoun-referent mappings and dynamically update the discourse model following a change of referent status. Recent research shows that pronouns and other referring expressions that require sensitivity to pragmatic and context-dependent information remain variable even in highly proficient second language (L2) speakers, and become unstable in speakers experiencing native language (L1) attrition from a proficient L2. Both groups converge on a tendency to be over-explicit in pronoun production and interpretation. I consider an explanation of these phenomena based on the interaction of language processing and cognitive control. Specifically, I argue that the computation of anaphoric dependencies in bilinguals is affected by a trade-off between enhanced inhibitory control and inconsistently efficient integration/updating of probabilistic and unpredictable information (Braver 2012; Goschke & Dreisbach 2008): these are two sides of the same coin. There is both inter- and intra-individual variation in the regulation of this conflict, especially in late bilinguals. Variability in pronoun use could be regarded as a bilingual disadvantage, when compared to monolingual norms. Alternatively, the convergence between L1 and L2 may be a marker of flexibility and the result of a reconfiguration of the cognitive system that allows successful late bilinguals to handle two languages but makes them unlike monolinguals in either the L1 or the L2. If we give up the monolingual comparison, it is more appropriate to refer to bilingual *effects* rather than bilingual advantages or disadvantages.

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### Is Cognitive Control Involved in Accommodating a Switch in Language During Bilingual Comprehension?

MARGARITA KAUSHANSKAYA, *University of Wisconsin-Madison*.

We examined whether bilingual children would experience difficulties when processing a language switch under ideal listening conditions (in quiet, Experiment 1), and under realistic listening conditions (in noise, Experiment 2). We also tested whether the ability to accommodate a language switch would be predicted by performance on a non-verbal cognitive control task. Simultaneous balanced bilingual children (*Mean Age*=9.14) were tested. To examine the impact of intra-sentential code-switching on language processing, an auditory moving window (AMW) paradigm was used, where children listened to sentences unfold one phrase at a time, and were told to push a key in order to hear the next phrase. Each sentence was presented in four conditions – English; Spanish; English-Spanish switch; and Spanish-English switch. In Experiment 1, all stimuli were presented in quiet. In Experiment 2, all stimuli were embedded in speech-modulated noise with SNR of 0. All children also completed a Dimensional Change Card Sorting (DCCS) task. Analyses of Experiment 1 AMW data revealed a robust effect of language switch on RTs ( $p<.001$ ,  $\eta_p^2=.027$ ). However, RT costs were not associated with switching costs on the DCCS task ( $\Delta R^2=.018$ ,  $p=.25$ ). Analyses of Experiment 2 AMW data revealed similar results, as well as an association between AMW and DCCS performance. However, task-shifting was related to sentence processing in noise in general, and not to processing of code-switched sentences in particular. We conclude that bilingual children's ability to accommodate a language switch in the input

does not appear to be related to domain-general cognitive-control abilities.

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### Is Susceptibility to Cross-language Interference Domain Specific?

ANAT PRIOR, TAMAR DEGANI, SEHRAB AWADY, RANA YASSIN, NACHSHON KOREM, *University of Haifa*.

Interference from L1 is a major source of difficulty for L2 learning and processing, suggesting that at least some of the variability in second language achievement could be attributed to individual differences in the ability to successfully overcome interference from the L1 during L2 processing. Recently, it has been claimed that bilinguals and language learners recruit domain general executive functions (EF) to manage language competition. In the current study, we examined L2 proficiency and executive functions as possible predictors of susceptibility to L1 interference during L2 processing. 70 Arabic-Hebrew bilingual university students performed two tasks indexing cross language interference (from L1 to L2). Lexical interference was assessed using a cross-modal semantic similarity judgment task in Hebrew, with false-cognates as critical items. Syntactic interference was assessed using a self-paced reading paradigm and grammaticality judgments on Hebrew sentences whose syntactic structures differed from those of Arabic. EFs were examined using spatial and numerical Stroop task, to index inhibitory control, and a task switching paradigm, to index shifting abilities. There was significant L1 interference across the lexical and syntactic domains, but these were not correlated, and neither type of interference was related to domain general EF abilities. Finally, susceptibility to syntactic interference, but not to lexical interference, was reduced with greater L2 proficiency. These results suggest at least partially independent mechanisms for managing interference in the two language domains, and raise questions regarding the degree to which domain general control abilities are recruited for managing L1 interference.

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### Might Linguistic and Nonlinguistic Control be related?

ZOFIA WODNIECKA, *Jagiellonian University, Penn State University*, JAKUB SZEWCZYK, JOANNA DURLIK, PATRYCJA KAŁAMAŁA, *Jagiellonian University*.

A possible impact of language training on the enhancement of cognitive control has been hotly debated. It is been suggested that linguistic and cognitive control might have common substrates, which should make the training effects possible. Here, we explore possible transfer effects by investigating the extent to which various indices of cognitive and language control covary with each other in a large longitudinal dataset. Across a two year period, we assessed a group of 63 high-school students, Polish native speakers with intermediate knowledge of English. At each of the three testing points, participants performed a battery of tasks that had been previously used to assess various aspects of cognitive and language control: Stroop task, Eriksen Flanker task, task switching, running span task, language switching, semantic and phonological verbal fluency and an interlingual homograph task, as well as background measures such as L1 and L2 proficiency and IQ. Most of the measures varied strongly across participants and testing times. Crucially, the analyses showed almost no clustering across the indices of linguistic and nonlinguistic control. As such, the aspects of

language control captured by the commonly used psycholinguistic tasks appear largely unrelated to the nonlinguistic control measures. We report isolated instances where the co-variation was present. We discuss how these results inform theorizing about possible transfer effects between the two domains of control.

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## MACHUCA ROOM, SATURDAY 7TH MAY, 17:20-18:40 SY26 The Future of Methodology in Psychological Science

### The Peer Reviewers' Openness Initiative: Incentivising Open Research Practices through Peer Review.

RICHARD D. MOREY, *Cardiff University*.

Openness is one of the central values of science. Open scientific practices such as sharing data, materials, and analysis scripts alongside published articles have many benefits, including easier replication and extension studies, increased availability of data for theorybuilding and metaanalysis, and increased possibility of review and collaboration even after a paper has been published. Although modern information technology makes sharing easier than ever before, uptake of open practices had been slow. We suggest this might be in part due to a social dilemma arising from misaligned incentives, and offer a specific, concrete mechanism – reviewers withholding comprehensive review – to achieve the goal of creating the expectation of open practices as a matter of scientific principle.

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### The Availability of Psychological Research Data.

WOLF VANPAEMEL, *KU Leuven*.

Making research data publicly available has several benefits for the advancement of science. Data sharing facilitates, among others things, verification, replication, robustness check, reuse, follow up, and meta-analysis, and thus leads to a more reliable, less wasteful, less costly, more efficient and overall better science, as well as to an increased confidence in research findings and a greater trust in science. I give an overview of studies that have estimated the availability of psychological research data, all of which have revealed worryingly low rates of sharing, and discuss reasons why authors are generally unwilling to share their data.

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### On Knowing how the Sausage is Made: The Pros and Cons of Open Review.

ROLF A. ZWAAN, *Erasmus University Rotterdam*.

There is a distinct movement toward greater transparency in psychological research. Part of this movement is the emergence of open peer review. In its earliest incarnation in the 17th century, peer review was performed by a journal editor or by a small group of editors. In the 20th century, the current tradition of separating the roles of editor and reviewer and of selecting reviewers from those not affiliated with a journal was formed. In the vast majority of cases, peer review has been closed. Only the editor, the reviewers,



and the authors are allowed access to the reviews and action letters. In recent years, some journals have adopted an open review policy. Reviews and action letters are published along with the paper. I will discuss the pros and cons of such a system against the background of the current reproducibility crisis in psychology. Could open review have prevented some of our field's current problems?

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### **The Dark Side of Open Science: Weaponizing Transparency.**

STEPHAN LEWANDOWSKY, *University of Bristol.*

Government should be transparent. Science should be open. Government information belongs into the public domain, and scientific data should be publicly available to permit replication and scrutiny. Few would disagree with those basic principles of an open and democratic society. However, does openness and transparency come with hidden adverse consequences? Are there limits on transparency and openness and if so, where should they be drawn? What are the likely consequences of continued calls for openness and transparency? I review some of the literature on transparency in government and public policy which argues that a "naked government" is ultimately undemocratic, and I discuss several scenarios involving contested areas of science in which openness has been successfully "weaponized", for example by the tobacco industry, to undermine well-established scientific findings and create doubt in the public's mind for political purposes. I propose that to safeguard Open Science it needs to be carefully delineated.

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FALLA ROOM,

SUNDAY 8TH MAY, 8:00-10:00

## **SY27 The Influence of Orthography on Spoken-Word Recognition?**

### **The Effect of Learning to Read on the Neural Systems for Vision and Language: A Longitudinal Approach with Illiterate Participants.**

FALK HUETTIG, *Max Planck Institute for Psycholinguistics*, UTTAM KUMAR, *Centre of Biomedical Research*, RAMESH K MISHRA, *University of Hyderabad*, VIVEKA TRIPATHI, *University of Allahabad*, ANUPAM GULERIA, *Centre of Biomedical Research*, JAY PRAKASH SINGH, *University of Allahabad*, FRANK EISNER, *Radboud University*. How do human cultural inventions such as reading result in neural re-organization? In this first longitudinal study with young completely illiterate adult participants, we measured brain responses to speech, text, and other categories of visual stimuli with fMRI before and after a group of illiterate participants in India completed a literacy training program in which they learned to read and write Devanagari script. A literate and an illiterate no-training control group were matched to the training group in terms of socioeconomic background and were recruited from the same societal community in two villages of a rural area near Lucknow, India. This design permitted investigating effects of literacy cross-sectionally across groups before training (N=86) as well as longitudinally (training group N=25). The two analysis approaches yielded converging results: Literacy was

associated with enhanced, left-lateralized responses to written text along the ventral stream (including lingual gyrus, fusiform gyrus, and parahippocampal gyrus), dorsal stream (intraparietal sulcus), and (pre-) motor systems (pre-central sulcus, supplementary motor area) and thalamus (pulvinar). Significantly reduced responses were observed bilaterally in the superior parietal lobe (precuneus) and in the right angular gyrus. These effects corroborate and extend previous findings from cross-sectional studies. However, effects of literacy were specific to written text and (to a lesser extent) to false fonts. We did not find any evidence for effects of literacy on responses in the auditory cortex in our Hindi-speaking participants. This raises questions about the extent to which phonological representations are altered by literacy acquisition.

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### **No Role for Orthography in Recognizing Casual Speech.**

HOLGER MITTERER, *University of Malta*, EVA REINISCH, *University of Munich.*

The evidence for a role of orthography in speech perception is mostly based on studies using single-word presentation in "lab-speech" style. The present study tested the role of orthography in listening to casual, connected speech, where massive inconsistencies between spoken form and orthographic representations due to segment deletions make an involvement of orthography less likely. The experiments used the visual-world paradigm ("click on the (h) ouse") and compared deletion costs for word recognition caused by deleting the German glottal stop (no orthographic coding) with the costs caused by deleting the orthographically coded German /h/ and the Maltese glottal stop. If orthographic coding matters, the deletion of the German glottal stop should be less detrimental than the deletion of the other two orthographically coded segments. The results, however, revealed deletion costs which were similar for all three segments. A second experiment then tested whether the failure to find evidence for an influence of orthography might be due to the use of the phonetically unusual glottal stop. To this end, the items were re-recorded in a careful manner and in short phrases rather than complete sentences. Participants were asked to rate the pronunciation of the target word, and these ratings showed an orthographic effect: Deletion of the German glottal stop affected pronunciation ratings less than deletion of the two orthographically coded segments. These data indicate that the use of orthography is restricted to careful speech and/or explicit tasks, while, in normal conversation, orthography probably has no role to play.

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### **How Much Does Orthographic Exposure Influence Processing of Schwa in Novel Spoken Words?**

JAMES M. MCQUEEN, MIRJAM ERNESTUS, *Radboud University*, MALTE VIEBAHN, *Max Planck Institute for Psycholinguistics*, ULRICH H. FRAUENFELDER, AUDREY BÜRKL, *University of Geneva.*

Exposure to the printed form of a newly-learned word can influence subsequent phonological processing in speech production and recognition. For example, French speakers are more likely to name the pictured referent of the novel word "scobe" using a pronunciation variant with the vowel schwa inserted in the onset cluster if they have been exposed to the spelling <secobe> than if they have not, despite never having heard the schwa-inserted form. This study asked how large this influence of orthographic exposure



is, relative to that of auditory exposure to actual pronunciation variability. In two experiments, adult French participants learnt novel French spoken words in which schwa was either present (e.g. “*secobe*”) or absent (e.g. “*sco*be”). In Experiment 1, some words were presented during learning sometimes with and sometimes without schwa. In Experiment 2, this pronunciation variability manipulation was replaced by an orthographic exposure phase in which the schwa-absent variants were spelled either with or without the letter <e>. Naming and eye-tracking tasks were performed after learning. Results suggest that both auditory and orthographic information can influence phonological processing, in production and recognition. But the influence of auditory pronunciation variability far outweighed that of spelling, especially in production: The effect of auditory exposure on the proportion of schwa-present naming responses was 10 times larger than that of orthographic exposure. The relatively weak effect of spelling may be because orthographic information is a less reliable indicator of possible pronunciation, at least in French, than the actual phonological information provided by auditory exposure.

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### Does Literacy Shape Lexical Representations? – A Developmental Perspective.

ULRIKE SCHILD, ANNE BAUCH, CLAUDIA K. FRIEDRICH, *University of Tuebingen*. Comparing non-reading preschoolers with reading pre-schoolers and pupils we tested the hypothesis that phonological representations become more detailed when children learn to read. We focused on the processing of information inherent to the speech signal that finds a correlate at the letter level in German (phonemic information, Experiments 1 and 2) and on speech information that does not find a correlate at the letter level (syllable stress, Experiment 3). Across three experiments we used word onset priming. In Experiment 1, prime-target pairs varied in initial place of articulation (e.g., ‘Bra-‘Drache, Engl. dragon). In Experiment 2, prime-target pairs varied in initial place of articulation or voicing (e.g., ‘Bra-‘Drache or ‘Tra-‘Drache). In Experiment 3, prime-target pairs varied in syllable stress (e.g., dra-‘Drache). In Experiment 1, pre-readers’ lexical decision responses did not differ between the variation condition and an identical condition (e.g., ‘Dra-‘Drache). In Experiment 2, pre-readers’ insensitivity to variation in place of articulation was not replicated, but it appeared that they were less sensitive to voicing variation than readers. In Experiment 3, no group differences were found for stress manipulations. Together, those results suggest that if spoken word processing is more fine-grained in readers than in pre-readers, than this insensitivity is linked to aspects of the speech signals that are coded in the writing system.

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### The Influence of Literacy on Speech Perception.

KARL MAGNUS PETERSSON, ALEXANDRA REIS, *University of Algarve*.

The formal educational system is a structured process for cultural transmission. On this view, the educational system represents an institutionalized structure that subserves important aspects of socialization and cultural transmission. First, we briefly review cognitive, neuroanatomic, and functional neuroimaging findings showing that formal education influences important aspects of the

human brain, including object naming, word/pseudoword repetition, working memory, left-right differences and regional brain network interactions. Secondly, we present some new behavioral results on processing and awareness phonological form in sentence context which suggests subtle influences of literacy speech perception.

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### The Orthographic Effects in Speech Processing: Beyond the “Automaticity vs. Strategy” Debate.

CHOTIGA PATTAMADILOK, *Aix-Marseille Université*.

Behavioral evidence for the orthographic effects on speech processing was first observed in metaphonological tasks more than 30 years ago. This pioneering observation led to a long-standing debate on the automaticity of the effects. In spite of a huge amount of work devoted to tease apart the automatic vs. strategic account of the orthographic influence on speech processing, this issue remains difficult to resolve in the context of metaphonological tasks. More recently, many research groups start using spoken word recognition tasks to probe the orthographic effects. This change of experimental paradigm combined with recent data from brain imaging studies have shifted the focus of the debate from the automaticity issue to the cognitive and neural mechanisms underlying the contribution orthography to speech processing. During the talk, I will present studies that shed light on this issue. The implication of these findings on speech processing models will be discussed.

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## ANDALUCIA I & II ROOM, SUNDAY 8TH MAY, 11:00-12:40 SY28 Is Ordinal Processing the Missing Link between Symbolic Number Processing and Calculation?

### The Ordinal Instinct: A Neurocognitive Perspective.

ORLY RUBINSTEN, *University of Haifa, Israel and Israel Science Foundation*.

The current presentation focuses on the hypothesized ordinal instinct. It is suggested here that order, much like colour, is a basic feature of the environment to which humans appear wired to attend by instinctively extracting approximate ordinal relations. This suggested ordinal instinct, is tuned to optimally pick up ordinal information by implicitly capturing sequential regularities in the surrounding world. Results of several different experiments will be presented, suggesting the existence of such a neurocognitive system designed to evaluate ordinal relationships. The basic paradigm presents participants with 3 numbers of stimuli (groups of dots or Arabic numerals) in an ordered or non-ordered form. Typically, the participant’s task is to indicate whether the stimuli are ordered or not. Ordinality is measured by the differences in reaction times or accuracy rates of ordered vs. non-ordered stimuli. Numerosity is measured by the differences in reaction times or accuracy rates of the different ratios between every two adjacent groups of dots. Our event-related potentials (ERPs) findings, revealed differences in the time course of neural responses to ordinality vs. numerosity. Moreover, ordinality is processed very early post stimulus presentation, even too early to be attentively or explicitly processed





or computed. In addition, using the Continuous Flash Suppression (CFS) methodology, it was found that ordinality primed quantity suggests that participants did implicitly process the unattended prime (ordinality) masked by the CFS methodology. Hence, it is argued that human numerical intelligence relies on the ordinal instinct through biological development and experience.  
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### **The Role of Working Memory in Cardinality Judgment, Ordinality Judgment and Calculation.**

HELENE VOS, *University of Leuven Belgium*, WIM GEVERS, *Université Libre de Bruxelles*, BERT REYNVOET, *University of Leuven Belgium*.

Working memory is a cognitive system with the function to store and process information. Consequently, WM is involved in a wide array of cognitive tasks. In the literature, several working memory models have been proposed. On the one hand there are structural models like the multi-component model of Baddeley & Hitch taking the structure of working memory as starting point. On the other hand, embedded-processes models like the working memory model of Oberauer focus on the functional organization of working memory. In the present study, the influence of working memory on mathematical ability is evaluated from both structural and functional viewpoint in adults. The influence of working memory on different number processing tasks is investigated including cardinality judgments, ordinality judgment, fact retrieval and calculation. By doing so, we hope to gain insight in the underlying cognitive mechanisms of number processing.

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### **A Mediating Role for Serial Working Memory in the Relationship between Digit Comparison and Arithmetic?**

DELPHINE SASANGUIE and BERT REYNVOET, *University of Leuven Belgium*.

Previously, Sasanguie et al. (submitted), unraveled the well-established relationship between digit comparison and arithmetic and revealed that the ability to judge whether symbolic numbers are in numerical order – i.e. digit ordering ability – partly mediated that relation. Moreover, when also non-numerical (letter) ordering was entered into the model, they observed a full mediation. This suggests that accessing and activating existing ordinal representations plays a role in explaining the relation between digit comparison performance and arithmetic in adults. Specifically, the combination of both over-learned numerical ordinal representations and ordinality-related control processes in working memory fully account for that relationship. To explicitly test the latter hypothesis, in the current study, we replaced the letter ordering task by a serial order working memory task in the mediation model and investigated whether the performance on this task could indeed fully account for the relationship between digit comparison and arithmetic in adults. Data are currently gathered and analyzed and will be discussed at the conference.

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### **Procedural and Retrieval Strategies in Addition Problem Solving.**

KIM UITTENHOVE, CATHERINE THEVENOT, PIERRE BARROUILLET, *University of Geneva*.

Contrary to a widespread assumption, recent studies suggest that adults do not solve very small additions by directly retrieving their answer from memory (Barrouillet & Thevenot, 2013; Fayol & Thevenot, 2012). We present additional response time data of ninety adult participants solving the 81 additions with operands from 1 to 9. When focusing on very small problems (i.e. with operands  $\leq 4$ ) that were reported by participants as being solved by direct retrieval, response times showed a strong linear increase with the magnitude of the operands. Rather than advocating the use of retrieval, this type of result testifies for the involvement of a sequential multistep procedure in this type of problem, with the number of steps defined by the size of the operands. However, the pattern of response times for other small problems (i.e., with only one operand  $\leq 4$ ) was compatible with the use of retrieval. These findings suggest the use of both retrieval and procedural strategies by adults when solving small addition problems (i.e., sum  $\leq 10$ ). However, the priority by which these strategies are used differs significantly from what is described classically in the literature, with a much larger role for procedures on much simpler problems than was previously assumed. After presenting the supporting data, we discuss the nature of these procedures, which could have been compiled and automated in adulthood and could heavily rely on numerical ordinal processing.

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### **Running the Number Line: Rapid Shifts of Attention in Single-Digit Arithmetic.**

ROMAIN MATHIEU, AUDREY GOURJON, AURIANE COUDERC, *CNRS and University of Lyon*, CATHERINE THEVENOT, *University of Geneva*, JEROME PRADO, *CNRS and University of Lyon*.

It has been recently proposed that adults might solve single-digit addition and subtraction problems by rapidly moving through an ordered representation of numbers. In the present study, we tested whether these movements manifest themselves by on-line shifts of attention during arithmetic problem-solving. In two experiments, adult participants were presented with single-digit addition, subtraction and multiplication problems. Operands and operator were presented sequentially on the screen. Although both the first operand and the operator were presented at the center of the screen, the second operand was presented either to the left or to the right side of space. We found that addition problems were solved faster when the second operand appeared to the right than to the left side (Experiments 1 & 2). In contrast, subtraction problems were solved faster when the second operand appeared to the left than to the right side (Experiment 1). No operation-dependent spatial bias was observed in the same time window when the second operand was zero or when the operation was a multiplication (Experiment 1 & 2). Therefore, our results demonstrate that solving single-digit addition and subtraction, but not multiplication, is associated with horizontal shifts of attention. Our findings support the idea that mental movements to the left or right of a sequential representation of numbers are elicited during single-digit arithmetic.

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PAPERS





FALLA ROOM,  
THURSDAY 5TH MAY, 15:20-17:00

## TS01 Bilingualism I

### Second Language Exposure Modulates The Bilingual Advantage.

EVY WOOMANS, VALERIA MOROZOVA, WOUTER DUYCK, Ghent University.

In the field of psycholinguistics, the ‘bilingual advantage’ is a much-debated phenomenon. Several studies have reported enhanced cognitive performance in bilinguals comparing them to monolingual peers, but these findings are now increasingly being called into question. The discrepancy between the different results may be a result of the diverging types of bilinguals that are tested. So far, only few studies have actually focused on how different linguistic experiences may modulate bilingual cognition. The present study set out to identify the role of second language (L2) exposure on cognitive development in bilingual children. Specifically, we explored whether L2 exposure is a determining factor in the bilingual advantage phenomenon. In order to isolate the effects of L2 exposure, we recruited younger (circa age six) and older (circa age eleven) children, all early and proficient bilinguals. We also included groups of matched monolingual controls. Both a flanker and a Simon task were employed to measure cognitive control. Results showed no sign of any benefits for the younger bilinguals (with five to six years of L2 exposure), but they became very apparent for the older bilinguals (with ten to eleven years of L2 exposure). Hence, we believe the amount of L2 exposure is an important factor in determining the magnitude of the bilingual control advantage and explaining its occasional absence. Conceivably, the bilinguals in those studies may not have had sufficient L2 exposure to lead to improved cognitive skills.

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### Source Recognition and List Discrimination in Bilinguals.

WENDY S. FRANCIS, E. NATALIA STROBACH, MICHELLE MARTINEZ, University of Texas at El Paso.

When bilinguals intentionally encode and retrieve words, they are better at recalling L1 words and better at recognizing L2 words (Francis & Strobach, 2013). Two bilingual experiments investigated whether performance on source recognition and list discrimination tasks would depend on the language in which the information was presented. In Experiment 1, highly proficient Spanish-English bilinguals learned sets of high-frequency words and sets of low-frequency words in each language, with half of the words in each set appearing on the left side of the monitor and half appearing on the right side. After intentionally encoding each sequence, they indicated whether each word had appeared on the left or right side. Source identification was better for low- than high-frequency words, but equivalent for L1 and L2. In Experiment 2, bilinguals learned sets of high- and low-frequency words in each language, with half of the words in each set occurring in List 1 and half appearing later in List 2. After intentionally encoding each set of two lists, they indicated whether each word had appeared in List 1 or List 2. The results of these two experiments suggest that the mechanisms underlying recognition of content may be different from those underlying recognition of the associated spatial or temporal context. Also, L2 words do not always function as low

frequency L1 words.

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### Attentional Processes in Albanian-Greek Bilinguals: Does the Level of Bilingual Experience Matter?

ELISAVET CHRYSOCHOO, ARISTEA LADAS, VASILIKI SALVARI, ANA B. VIVAS, The University of Sheffield International Faculty, City College.

Evidence shows that in order to communicate efficiently, bilinguals engage daily in language-control to suppress intrusions from the irrelevant language. This form of cognitive training is assumed to generalize to non-linguistic tasks of executive control of attention. However, findings on such a “bilingual advantage” are often difficult to replicate. The present study explored the three attentional functions in a sample of 46 young adults Albanian-Greek bilinguals, who were carefully matched with Greek monolinguals on age, gender, non-verbal intelligence, and SES. Participants were given the *Attentional Network Test* providing measures of executive attention, alerting, and orienting. In order to investigate the modulation of the bilingual advantage effect by the bilingual experience level, bilinguals were also given a language-switching task. Results showed that bilinguals had a smaller vocabulary in Greek, and slower overall response times than monolinguals. However, we failed to replicate the bilingual advantage: the groups did not differ in any of the attention measures. Furthermore, the amount of bilingual experience, as measured by the absolute language switching cost, did not correlate with the attention network scores. The lack of a bilingual advantage in our sample is in agreement with findings in our lab with children and older adults (Ladas, Carroll & Vivas, 2015), as well as with other recent studies (Duñabeita et al., 2014). It seems that when bilinguals and monolinguals are carefully matched on variables that influence cognitive performance, such as SES, the bilingual advantage is attenuated (Ladas et al., 2010) or, as in the present study, completely eliminated.

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### The English Disease in Finnish Compound Processing: Evidence from Eye Movements.

RAYMOND BERTRAM, University of Turku, VICTOR KUPERMAN, McMaster University.

The increasing influence of English as L2 can be observed by the interference it introduces in native language processing. One instance of backward language transfer from English to Finnish is the insertion of spaces in Finnish compounds. By spelling regulation Finnish compounds can only occur in concatenated format (syntämäpäivä ‘birthday’; ostoskassi ‘shopping bag’) or hyphenated format (vaihto-ohjelma ‘exchange program’), but they nevertheless regularly appear in spaced format (syntymä päivä, ostos kassi, vaihto ohjelma). This phenomenon is called the English disease, as it presumably occurs under the influence of English, where the majority of compounds appear in spaced format (Kuperman & Bertram, 2013). In the current eye movement study, we examined a) to what extent illegal spacing affected Finnish compound processing; b) whether the regular format of the English Translation Equivalent (ETE) affected spaced Finnish compound processing. To this end, Finnish-English bilinguals read sentences including either spaced or concatenated Finnish compounds which either had spaced or concatenated ETEs (syntymäpäivä, syntymä

päivä, ostoskassi, ostos kassi), while eye movements were being registered. The results showed an initial advantage for spaced compound processing as indexed by first fixation duration, but a large processing cost at a later stage as assessed by gaze duration. The processing cost was smaller though for spaced compounds with a spaced ETE. This congruency effect indicates that both the English and Finnish lexicons are activated simultaneously and that possible spelling confusion may partly be dealt with by the same backward transfer mechanism that introduced it in the first place.  
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### Language Control in Bilingual Language Comprehension: Evidence from the Maze Task.

XIN WANG, *University of Greenwich*, YONSIA WHITE, DAPHNE NG, *University of Oxford*.

Ample empirical evidence in language production research has demonstrated processing costs associated with language switching in bilinguals. In the domain of language comprehension, however, it is far from conclusive whether/how such cognitive costs incur when bilinguals switch from one language to the other. The current study aims to investigate the locus of inhibitory control and the impact of sentence context on language switching in language comprehension. In addition, this study adopted the maze reading paradigm (Forster et al., 2009), which limits strategies available to readers in other paradigms (e.g., eye-tracking, self-paced reading) and reduces spillover effects, thus providing a more accurate measure of language switch effects at the word level. In this paradigm, participants have to continue a sentence from the first word/trial to the last word/trial by choosing one of the two alternatives presented on the screen, only one of which is grammatically or lexically acceptable. Experiments 1-2 measured the switch costs incurred when same-script Dutch-English bilinguals vs. different-script Chinese-English bilinguals process co-switched sentences that simulate code switching in real life. Reading times were compared between the code-switched and non-switched conditions (e.g., *I polished my 鞋 yesterday* vs. *I polished my shoe yesterday*, *鞋 and shoe are translation equivalents*). The preliminary results showed that switch costs incurred for both groups of bilinguals. However, same-script bilingual showed larger switch costs than different-script bilinguals. Experiments 3-4 measured whether these effects incurred when both same-script and different-script bilinguals switched languages without the sentential contexts. Instead of sentences, they were presented with a word and non-word on each trial and required to select the word to continue the task. A comparison between Experiments 1-2 and Experiments 3-4 demonstrates effects of sentence contexts on switch costs. Findings will be discussed relation to current bilingual models.

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## ANDALUCIA I & II ROOM, THURSDAY 5TH MAY, 15:20-17:00 TS02 Letter/Word Processing I

### Letter Bigram Effects in Visual Word Recognition.

XENIA SCHMALZ, CLAUDIO MULATTI, *Università degli Studi di Padova*, REMO JOB, *Università degli Studi di Trento*.

Letter bigram frequency (BF) relates to the position-specific frequency with which each letter pair co-occurs in an orthography. Whether a word's average BF affects reading processes has been studied across decades, but the existing data provide conflicting evidence. While some experiments show no effect of BF in a visual lexical decision task (e.g., Gernsbacher, 1984), others report facilitatory (e.g., Biedermann, 1966) or inhibitory (e.g., Chetail et al., in press) effects. We aim to resolve these inconsistencies by combining large-scale database analyses and experiments. First, we use Bayes Factor analyses to demonstrate that there is no effect of bigram frequency in lexical decision mega-databases (Balota et al., 2007; Keuleers et al., 2012). We follow up with targeted experiments to assess whether bigram frequency might affect a specific process underlying single-word processing. First, we study the importance of BF for the letter position and/or identity coding, using a transposed-letter priming experiment. This serves to address the possibility that the effect of BF is only observed in the early stages of the word recognition process, and may be washed out by lexical processes when the task taps higher-order word recognition. We further explore the possibility that BF effects may emerge in lexical decision if participants adopt non-lexical guessing strategies. The question of whether BF affects reading processes, and if so, by what mechanisms, is theoretically important, as it can provide information about the interaction between cognitive mechanisms of reading, and lower-level perceptual and task-dependent processes.

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### The Effect of Working Memory Capacity on Word Recognition Speed in Arabic Second Grade Readers.

ELMIR MOHAMMED, *University Sidi Mohamed Ben Abdellah, Fes Morocco*.

Introduction: The current study examined the effect of working memory capacity (WMC) on word recognition speed (WRS). Previous findings have related difficulties in WRS to deficits in WMC (Leather & Henry, 1994; Kail & Hall, 1994; Siegel & Ryan, 1989; Swanson, 2003; Swanson and Siegel, 2001). Correlations between WRS and WMC were established in alphabetic orthography (e.g. English) (Kail & Hall, 2001), and morphemic orthography (e.g. Chinese) (So & Siegel, 1997). Few studies related word recognition to working memory in Arabic orthography (Abu-Rabia, 1995; Abu-Rabia & Siegel, 2004), but without a clear mention to the effect of WMC on WRS. So we assume that high WMC readers are faster than low WMC readers in word recognition.

Subjects: 64 native Arabic children participated in this study.

Material: We tested childrens in Word Recognition Speed and Modified Digit Span.

Procedure: Children were tested individually by the author.

Results: The findings indicate striking differences between good and poor readers in WRS and WMC. Results indicate that increase in WMC leads to decrease in reading time. So slowness in word naming is due to deficits in WMC.





Discussion: The obtained results show that slowness in word naming is caused by deficiencies in WMC. We deduce that WMC influences reading in Arabic orthography like in other orthographies. Weak achievement of Arabic readers in WRS was probably caused by limited WMC, which indicates that high WMC reduces reading time.

### **WordGame: Investigating Visual Word Recognition “In the Wild”.**

SASCHA SCHROEDER, *Max Planck Institute for Human Development.*

In this talk, I will introduce “WordGame”, a project that examines visual word recognition outside the laboratory and how it changes across the lifespan. WordGame is an interactive exhibit on display in several German museums since 2013. It uses a social, game-like version of the progressive demasking task: In each round, one word – randomly drawn from a pool of 10,000 words – is incrementally displayed to two players. If one of the players recognizes it, he or she can hit a buzzer and type the word using a keyboard. Correct answers yield points needed to win the game. On each trial, response accuracy and latency is recorded. In addition, players are asked to indicate their age at the end of the game. By now, 25,000 persons covering an age range from 6 to 85 years have played this game. First analyses using mixed-effect modelling show that for both response accuracy and latency, non-linear inhibitory effects are found for word length and neighborhood density, while word frequency effects were linear and facilitative. The efficiency of the word recognition process strongly increased during childhood and adolescence, remained stable during early adulthood, and slowly decreased from age 40 onwards. In addition, while length effects differed very little between age groups, frequency and neighborhood effects increased linearly across the lifespan. Together, this indicates that the word recognition system becomes gradually more fine-tuned to lexical information with increasing language experience. Email: Sascha Schroeder, [sascha.schroeder@mpib-berlin.mpg.de](mailto:sascha.schroeder@mpib-berlin.mpg.de)

### **Steady-State Evoked Potentials in Visual Word Recognition.**

VERONICA MONTANI, JONATHAN GRAINGER, JOHANNES C. ZIEGLER, *CNRS & Aix-Marseille University.*

Frequency tagging has become a powerful tool for understanding a variety of cognitive processes. This technique relies on measuring steady-state evoked potentials (SSVEPs) that are induced by flickering visual stimuli at a certain frequency. Importantly, the use of multiple stimulation frequencies allows us to simultaneously measure responses related to different parts of the stimulus, making it a promising technique to study the hierarchical organization of written word representations. Here, we investigated the possibility to use SSVEPs and frequency tagging to study visual word recognition. Our approach is based on the previous finding that the amplitude of the SSVEPs provides a measure of the cognitive and attentional resources allocated to the stimulus (i.e. increased SSVEPs to attended parts of the stimulus). In particular, the aim of the first experiment was to investigate to what extent it would be possible to detect reliable SSVEPs using orthographic material and to validate our approach replicating the standard effects usually observed in visual word recognition (i.e. lexicality, frequency). In the second experiment, we investigated the role of sublexical phonological units, namely syllables, as functional units in word

naming, trying to highlight the nature of the representations that underlie reading aloud performance. Overall, our results show that words and word-like stimuli are able to evoke reliable SSVEPs and that the frequency tagging approach is a feasible method to investigate the functional units in word recognition and reading aloud.

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### **Development of the Perceptual Span.**

JOCHEN LAUBROCK, JOHANNES MEIXNER, JINGER PAN *University of Potsdam.*

Reading is a complex skill, requiring the coordination of cognition, attention, and eye movements. Parafoveal preprocessing shows that attention is allocated not only to the fixated word, but also to its right neighbor(s). The perceptual span is a measure of parafoveal preprocessing during reading. How does the perceptual span develop? Here we present results from the first longitudinal study on the development of the perceptual span, with data obtained from yearly measurements (T1 to T4) of German first- to third-graders (at T1). A measure of the span is derived using nonlinear mixed-effects modeling with an asymptotic growth rate function. Analysis of individual-level parameter estimates from this function is used to investigate whether initial difference between slow and fast readers are compensated, stable, or inflated with over time, i.e. with further reading experience. After three points of measurement, a pattern of stable or even increasing differences is indicated. Results further suggest that parafoveal preprocessing can only be used effectively when efficient and automatized foveal decoding and translation processes are in place. Currently obtained results from T4 will be integrated, and will allow us to judge the stability of the results and change scores. Taken together, these findings suggest that it is difficult to later compensate early deficiencies in basic process in reading, possibly because ongoing education might provide constant learning opportunities for better readers might, which at the same time overtax the worse readers.

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MACHADO ROOM,  
THURSDAY 5TH MAY, 15:20-17:00  
**TS03 False Memory**

### **What Determines Decisions and Actions, Believing That Something Happened Or Remembering It?**

GIULIANA MAZZONI, *University of Hull.*

Nonbelieved memories are vivid autobiographical memories for personal events that are no longer believed to have happened. Yet, they retain strong recollective qualities. No previous work has examined the behavioral consequences of vivid personal non-believed memories. The results of four studies are presented in which decision and action are measured when belief and memory about past experiences are incongruent within the same individual (remembered but not believed events/believed but not remembered events). In all four studies the dissociation between memories and the belief in the occurrence of the event they represent is obtained in the lab following procedures already shown to be effective (Clark et al, 2012; Mazzoni et al, 2014). The procedure involves

either creating false memories for actions and experiences and then debriefing participants about the real nature of the memory they have developed, or to provide convincing evidence that a true memory is instead false. After these procedures typically a substantial percentage of participants develop one or more non-believed memories. Results show that in case of major incongruency between remembering and the belief, participants discount the informative value of the memories, and base decisions and actions on belief only, independently of the strength of the memories recollective quality. However, this is obtained only for overt decisions and actions that have discreet values (yes/no decisions, choices among a discreet number of alternatives etc). Covertly, recollective qualities are found to still influence decisions and actions.

These results are discussed in terms of the theoretical relationship between memory and belief and the necessity to set the two apart in memory studies.

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### Perceptual False Memory for Visually Similar Object Drawings.

CHRISTOPH STAHL, LAURA HENZE, FABIA HÖGDEN, *University of Cologne*.

It is debated whether false memory for pictures reflects activation of conceptual or perceptual codes. Previous research, using photographs, has supported the former account: Whereas true memory was accompanied by priming effects indicative of perceptual processing, false memory was not accompanied by priming, indicating that false memories for photographs arise in the absence of perceptual code activation. However, this interpretation hinges on the validity of the priming measure as an exhaustive indicator for perceptual processing. The present study repeatedly obtained false memory for drawings of visually similar but conceptually distinct objects, an effect that cannot be explained by conceptual codes. We tested whether, using these materials, the priming method was capable of detecting the perceptual nature of the underlying codes. Priming was found for true but not for false memory. The results indicate that the priming method is not an exhaustive measure of perceptual processes underlying false memory for visually similar objects. We discuss an account of the results as reflecting structural codes that are located in between the perceptual and conceptual levels.

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### The Neural Underpinnings of the Continued Reliance on Misinformation after Its Correction.

STEPHAN LEWANDOWSKY, ANDREW GORDON, SUSANNE QUADFLIEG, *University of Bristol*.

Research has frequently shown that discrediting information can continue to influence judgement and reasoning even after it has been retracted – the so-called ‘continued influence effect’. We used functional magnetic resonance imaging (fMRI) to examine the pattern of brain activation during the encoding and test of narratives that contain retractions and require memory to be updated. Participants listened to narratives that either contained a retraction of previously encoded information, or no retraction at all. Following the presentation of each narrative participants were required to indicate their degree of belief in statements that specifically probed their reliance on retracted information. In line

with our expectations, we found that participants’ gave significantly higher ratings to the statements if they followed a story containing misinformation and a retraction than on a baseline control story that contained neither retraction nor the initial information. Our functional data revealed enhanced anterior cingulate cortex (ACC) activity when participants encoded information challenging earlier claims compared to when it did not, consistent with previous research on perceptual conflict. During the test phase significantly increased brain activity was observed bilaterally in the inferior frontal gyrus and the dorso-lateral prefrontal cortex following retraction reports compared to no-retraction reports, resembling previous findings on selective memory retrieval and information updating. These results outline the first evidence of the functional contribution of distinct brain systems to the continued influence effect.

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### With Social Presence Comes Accuracy, with Isolation False Memories.

TERESA GARCIA-MARQUES, *ISPA- Instituto Universitario*, ALEXANDRE FERNANDES, MARILIA PRADA, *ISCTE-Instituto Universitário de Lisboa*, RICARDO FONSECA, *William James Center of Research*.

Social presence is known to modulate cognitive processing features such as spreading of activation and inhibitory monitoring mechanisms. Here we present a set of experiments that explore these effects in the context of false memories produced within a DRM experimental paradigm. By doing that, we offer preliminary evidence of how the social environment may modulate false memories. In presented experiments old and young-adults were asked to perform several memory tasks having to remember in each one of them a set of items associated with a critic lure. False memories, indexed by the recall of the critic lures at the same level of each of the real presented items, were higher in isolation conditions than in presence condition. The different pattern of results for old and young adults regarding veridical recognition and the similar effect of presence of other in reducing false memories suggests that this last effect can occur in both populations for different reasons (processes). Email: Teresa Garcia-Marques, [gmarques@ispa.pt](mailto:gmarques@ispa.pt)

### False Memories and False Perceptions: A Study in Spontaneous Confabulation.

M. TRIVIÑO, E. RÓDENAS, *Mind, Brain and Behaviour Research Center. University of Granada, San Rafael University Hospital Granada*, J. LUPIÁÑEZ, M. ARNEDO, *Mind, Brain and Behaviour Research Center, University of Granada*.

Introduction: Confabulations have been divided into mnesic (false memories) and non-mnesic (false perceptions or delusions) (Schnider, 2012). False memories are considered the result of a deficit either in early filtering or later monitoring processes on memory recall. However, no specific processes have been linked to false perceptions. This study aims to investigate the relation between these two types of confabulations.

Method: Three groups of participants (15 confabulators, 15 non-confabulators patients, 15 healthy participants) took part in the experiment. They all performed a visual search task in which they had to touch an object (target) that was presented on a computer screen among distractors. The similarity of the distractors could be physical or semantic. In 50% of the trials (target-absent) only



distractors were presented. Confabulators performed the task twice, before and after a specific treatment aiming at reducing the mnemonic confabulations, whereas the remaining participants only performed the task once.

Results: An ANOVA was carried out to compare the groups. Before the treatment, only the confabulators showed both false memories (in the baseline previous the treatment) and false perceptions (in the visual search task). After the treatment, both false memories and perceptions significantly decreased in the confabulators group, thus disappearing the between groups differences.

Discussion: This study suggests that a common deficit might underlie both types of confabulations. When memory traces or perceptual objects share many characteristics, a competition between interconnected memory schemas is unavoidable (Gosh & Gilboa, 2014). Therefore, selective searching of relevant information is necessary to choose the correct schema and reject the competitors. According to our results, the origin of confabulations should be related to a deficit in an early selection process modulating the competition between interconnected memory schemas.

**PICASSO ROOM,  
THURSDAY 5TH MAY, 15:20-17:20  
TS04 Metacognition**

**Shared and Distinct Utilization of Accessibility for Monitoring throughout Problem Solving and Memorization.**

Yael Beller, Rakefet Ackerman, *Technion-Israel Institute of Technology*.

When comparing solving a briefly-phrased logic problem and memorizing its words, a central difference between the two is that while a healthy young adult may not be able to solve the problem regardless of the invested effort, a few words are memorable. Accessibility is a heuristic cue, known to underlie Feeling of Knowing (FOK), which reflects the amount of associations to the presented stimuli. In Experiment 1, accessibility utilization was examined with problems composed of word triads for three judgments: a) Initial Judgment of Solvability (iJOS)—a quick judgment whether a problem is solvable; b) final JOS (fJOS)—after giving up solving a problem, the assessed chance that it is nevertheless solvable; and c) confidence when providing a solution to the problem. In Experiment 2, accessibility utilization was examined when memorizing the word triads used in Experiment 1 for two judgments parallel to those collected for problem solving: a) Ease of Learning judgment (EOL)—a quick judgment whether the triad will be remembered; and b) Judgment of Learning (JOL)—the assessed chance to recall the second and third word when cued by the first word. Accessibility was predictive of all judgments. It misled iJOS and fJOS but was reliable for confidence, EOL, and JOL. Overall, the study exposes shared and distinct mechanisms between Meta-Reasoning and Meta-Memory processes.

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**Perceptual Fluency Affects Judgments of Learning when Feelings of Fluency Are Salient.**

Monika Undorf, Malte F. ZimdaHL, *University of Mannheim*, Daniel Bernstein, *Kwantlen Polytechnic University*.

When predicting future memory performance, people often judge that their memory will be better for words presented in a larger font size than for words presented in a smaller font size. Previous studies have found that this effect arises from people's beliefs about memory rather than from perceptual fluency. Based on these findings, we examined whether perceptual fluency affects judgments of learning (JOLs) when feelings of fluency are salient. We made feelings of fluency salient by presenting stimuli that were initially so small as to be entirely unrecognizable but that gradually increased in size. In Experiments 1 and 2, participants identified pictures of common objects and celebrities and made JOLs. Across trials, we manipulated the speed of the clarification process. Results showed that fast clarification increased JOLs indirectly by decreasing identification time. In Experiment 3, we replicated this finding using words. We conclude that perceptual fluency affects JOLs when feelings of fluency are salient.

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**Why are Children Overconfident? Developmental Differences in Implementation of Accessibility Cues when Judging Concept Learning.**

Mariette van Loon, *University of Bern & Maastricht University*, Anique de Bruin, *Maastricht University*, Claudia Roebbers *University of Bern*.

Background. Children are often overconfident when monitoring learning (when making Judgments of Learning, JOLs), this is harmful for effectiveness of control and learning outcomes. Main aims were a) to explain how JOL accuracy is affected by accessibility cues, and b) to investigate developmental changes in implementing accessibility cues in JOLs.

Materials and Methods. This study investigated children's (N = 167, 3<sup>rd</sup> – 6<sup>th</sup> grade) judgments of learning (JOLs) when studying difficult concepts. After studying concepts, children attempted to generate novel sentences, made JOLs, selected concepts for restudy, and finally took a test.

Results. Results show that overconfidence for incorrect and incomplete test responses declined with age. Further, for the older age groups, generation of a sentence led to more overconfidence than when the children were not able to generate a sentence. For the youngest age group, this pattern was different; these children were generally more overconfident, regardless of whether they were able to generate a sentence.

Conclusions. Presumably, older children relied more on accessibility cues when making JOLs, whereas younger children seemed to be more prone to a wishful thinking bias. Overconfidence was harmful for effective control of learning. This implies that children should be supported to accurately monitor learning by avoiding metacognitive illusions, and that such instructional support needs to be adapted to learners' developmental stage.

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### Task-Related Cognitive Interference is not Always Productive.

CHRISTOPHER A. WAS, RICHARD BEN HOLLIS, JESSE WRAY, *Kent State University*. Mind wandering or task-unrelated thoughts (TUTs) often lead to poor performance on the activity at hand. Although TUTs have been repeatedly demonstrated to have negative effects on cognitive performance, a specific type of interference has not been examined carefully. This variety of thinking comprises thoughts that are related to, but not specifically about the task at hand. For example, a student may be studying text about operant conditioning and her mind wanders to how she trained her dog to “speak” by giving it treats after it barked. Although this *task-related interference* (TRI) may appear to be beneficial due to the elaborative nature of the thought, the impact of TRIs has not been investigated. In the current investigation, we examined the effects of TUTs and TRIs on cognitive task performance and on judgments of learning (JOLs). Participants in this study watched a voice over Powerpoint® presentation and took a quiz over the content for course credit as part of a hybrid undergraduate course. During the 18-minute presentation participants were administered 6 mind wandering probes and then asked to make a JOL about the content just presented. Responses to the probe included on-task, a number of off-task (TUT), and task-related (TRI) options. Results indicate that when students reported TUTs, JOLs were lower and more accurate than when reporting on-task thoughts. However, when participants reported TRI, JOLs were largely overconfident. Overconfidence was most extreme when quiz items were difficult. Therefore, task-related interference may be contributing to a strong, false sense of knowing.

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### Metamemory in a Familiar Place: The Effects of Environmental Context on Feeling of Knowing.

MACIEJ HANCZAKOWSKI, *Cardiff University*, KATARZYNA ZAWADZKA, *Nottingham Trent University*, HARRIET COLLIE, BILL MACKEN, *Cardiff University*. Feeling-of-knowing judgments are judgments of future recognisability of currently inaccessible information. They are known to depend both on the access to partial information about a target of retrieval and on the familiarity of the cue that is used as a memory probe. In the present study we assessed whether feeling-of-knowing judgments could also be shaped by incidental environmental context in which these judgments are made. To this end, we investigated two phenomena previously documented in studies on recognition memory – a context familiarity effect and a context reinstatement effect – in the procedure used to investigate feeling-of-knowing judgments. In two experiments, we found that feeling-of-knowing judgments are increased in the presence of a familiar environmental context. The results of both experiments further revealed still higher feeling-of-knowing judgments when made in the presence of environmental context matching the encoding context of both cue and its associated target. The effect of context familiarity on feeling-of-knowing judgment was paralleled by an effect on the latencies of an unsuccessful memory search, but the effect of context reinstatement was not. Importantly, the elevated feeling of knowing in reinstated and familiar contexts was not accompanied by an increase in the accuracy of those judgements. Together, these results demonstrate that metacognitive processes are shaped by the overall volume of memory information accessed at retrieval, independently of

whether this memory information is related to a cue, a target or a context in which remembering takes place.

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### It's Context All the Way Down: The Impact of Filler-Item Difficulty and Default Options on the Strategic Regulation of Accuracy.

MICHELLE M. ARNOLD, TOBY PRIKE, PAUL WILLIAMSON, *Flinders University*. Context manipulations that are unrelated to the target stimuli can significantly influence the strategic regulation of accuracy for those targets. For example, more face recognition responses are volunteered when the faces are mixed in with harder (vs. easier) to remember words (Arnold & Prike, 2015). The current experiments extended this work by applying this type of comparative difficulty manipulation to grain-size, as well as by exploring a novel manipulation of the default decision option. Participants in Experiment 1 were allowed to choose whether to report either their fine-grained (specific) or coarse-grained (general) free-report responses for a set of medium-difficulty questions that were mixed in with either easy or hard questions. Experiment 2 was a multiple-choice general knowledge test that required participants to choose whether to volunteer (i.e., report) or withhold their answers, with the key manipulation being whether the default decision option was set to report, withhold, or blank (control). Both the comparative difficulty and default option manipulations affected strategic regulation, with the largest influence found on metacognitive bias. Therefore, these results add support to the growing research showing that context variables unrelated to the stimuli of interest (such as the comparative difficulty of test questions) are important to consider when exploring metacognitive judgments. Further, the results are in line with theoretical accounts of memory and metacognition that argue experiential states (e.g., remembering/knowing) are not static categories, but rather are inferential and thus depend on the parameters of a given situation to at least some degree.

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ALBENIZ ROOM,  
THURSDAY 5TH MAY, 15:20-17:20  
TS05 Cognitive Control I

### Bottom-Up Regulation of Control in Dual-Tasking: Sequential Modulations of Backward Crosstalk and Task-Shielding.

MARKUS JANCZYK, *University of Tübingen*.

The backward crosstalk effect (BCE) refers to improved Task 1 performance by characteristics of a subsequent Task 2. For example, RT1 is shorter when Task 1 and 2 responses are made on the same side (compatible trial) than when both are made on opposite sides (incompatible conflict trial). The size of the BCE can be interpreted as the degree to which Task 1 can be shielded against Task 2 processing. With three experiments, the present study investigates the impact of bottom-up factors on this, focusing on the recently experienced trial and conflict history. Experiment 1 shows that the BCE is only present following compatible trials, but absent following incompatible trials, similar to the Gratton effect in standard conflict tasks. Experiments 2 and 3 were run to





control for specific confounds that arise in this dual-task situation. The modulation was present, however, also when avoiding exact repetitions or complete alternations of stimulus-response episodes (Exp. 2) and when avoiding repetitions of response combinations (Exp. 3). These findings thus show a strong impact of recently experienced conflict on dual-tasking: Following conflict, either Task 1 shielding is increased or Task 2 automatic response activation is prevented. In sum, the present study informs theories of dual-task performance and adds to the evidence that the cognitive system flexibly regulates control even in dual-task settings to adapt to current environmental demands.

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### Stimulus Conflict Triggers Behavioral Avoidance.

DAVID DIGNATH, *University of Freiburg*, ANDREAS B. EDER, *University of Würzburg*.

According to a recent extension of the conflict monitoring theory, conflict between two competing response tendencies is registered as an aversive event and triggers a motivation to avoid the source of conflict. Five experiments are presented that tested this assumption and examined whether conflict is associated with an avoidance motivation and whether stimulus conflict or response conflict triggers an avoidance tendency. Participants first performed a color Stroop task. In a subsequent motivation test, participants responded to Stroop stimuli with approach- and avoidance-related lever movements. Results showed that Stroop-conflict stimuli increased the frequency of avoidance responses in a free-choice motivation test and the speed of avoidance responses relative to approach responses in a forced-choice test. High and low proportions of response conflict in the Stroop task had no effect on avoidance in the motivation test. Avoidance of conflict was however obtained even with new conflict stimuli that were not presented before in a Stroop task and when the Stroop task was replaced with an unrelated filler task. Taken together, these results suggest that stimulus conflict is sufficient to trigger avoidance.

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### Feeling the Context: The Role of Context-Evoked Conflict Experience in Context-Specific Conflict Adaptation.

HEIKO REUSS, WILFRIED KUNDE, *University of Würzburg*.

Humans are able to flexibly adapt to changing contexts that have been associated with a high or low probability of conflict, under particular conditions even when the conflicting stimuli are presented unconsciously. However, the underlying mechanisms that lead to (or prevent) unconsciously triggered context-specific conflict adaptation remain vague. Here we investigated how subjective conflict experience – an important factor for adaptation to recent conflict – plays a role in context-specific adaptation. We hypothesized that conflict experience gets associated with the context, and that the actual adaptation process is elicited by the context evoking this conflict experience.

In a masked priming paradigm, participants responded to a target arrow that was preceded by a masked prime arrow. The form/type of the target arrow represented a context of either low interference (20% incongruent trials) or high interference (80% incongruent trials). Importantly, after each trial participants indicated whether they experienced conflict or not. The results show that the high-interference context increased the probability to experience conflict, even when no conflict was actually present, indicating an

association between conflict experience and context. Yet, we found no adaptation effect: congruency effects did not differ between the two contexts. This initially surprising observation supports the assumption of Reuss et al. (2014) that when context information is presented late in the trial, it still can be associated with unconscious conflict, but the context information is available too late to be able to impact on quickly decaying unconscious conflict information.

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### Common Mechanisms of Inhibition Revealed Through Delta Plots.

CRAIG HEDGE, GEORGINA POWELL, PETROC SUMNER, *Cardiff University*.

Theories of response control typically assume that the inhibition of conflicting information is achieved through common mechanisms that manifest in a variety of tasks (e.g. Stroop, Eriksen Flanker, Simon). This assumption is supported by both neuroimaging and neuropsychological work, however, correlational studies often report no association between different measures of response control. One explanation for this inconsistency is that the traditional measures of performance in these tasks (e.g. reaction time costs) are not ideally suited to studying individual differences. Here, we use delta plots (de Jong et al., 1994; Ridderinkhof et al., 2004) to examine response control in multiple tasks. Delta plots show the effect of conflict as a function of response speed. The late portion of the delta plot is hypothesised to reflect the reduction of interference by an active response inhibition mechanism. In two datasets, we show that delta slopes correlate in the flanker and Simon tasks (N=50), and in the flanker and Stroop tasks (N=103), where traditional RT costs do not. These findings are indicative of common mechanisms of inhibition underlying individual differences in response control tasks, which may be obscured by examining simple differences between mean reaction times.

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### Time-Resolved Decoding of Two Processing Chains during Dual-Task Interference.

SEBASTIEN MARTI, JEAN-REMI KING, *CEA NeuroSpin Center*, STANISLAS DEHAENE, *CEA NeuroSpin Center, College de France*.

The human brain exhibits fundamental limitations in multitasking. When subjects engage in a primary task, their ability to respond to a second stimulus is degraded. Two competing models of multitasking have been proposed: either cognitive resources are *shared* between tasks, or they are allocated to each task *serially*. Using a novel combination of magneto-encephalography and multivariate pattern analyses, we obtained a precise spatio-temporal decomposition of the brain processes at work during multitasking. We discovered that each task relies on a sequence of brain processes. These sequences can operate in parallel for several hundred milliseconds, but beyond ~500 ms, they repel each other: processes evoked by the first task are shortened while processes of the second task are either lengthened or postponed. These results contradict the resource sharing model and further demonstrate that the serial model is incomplete. We therefore propose a new theoretical framework for the computational architecture underlying multitasking.

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### Disentangling Components of Preparation for a Task-Switch with Combined EEG and Eye-Tracking.

AURELIU LAVRIC, CAI S. LONGMAN, HEIKE ELCHLEPP, STEPHEN MONSELL, *University of Exeter*.

Theoretical accounts of task-set control, including computational models, assume task-set reconfiguration (TSR) is multi-componential. However, the identity, order and timing of components of TSR are debated. For example, in ECTVA (Logan & Gordon, 2001) all task-set parameters are transmitted in parallel, while in CARIS (Meiran, Kessler & Adi-Japha, 2008) processing is serial. Also debated is whether components of task-set reconfiguration are tightly coupled or largely independent. We conducted a task-cuing experiment requiring switches among three tasks associated with different locations. A well-documented 'signature' of preparation for a task-switch in brain potentials (ERPs) is a switch-induced positive-polarity deflection in the late part of the pre-stimulus (preparation) interval – from ~400-500 ms following the onset of the task cue (e.g., Lavric, Mizon, & Monsell, 2008). We have also documented a switch-induced delay in movement of the eyes from the cue to the task-relevant region, indicative of the cost of resetting spatial attention parameters (Longman, Lavric, Munteanu, & Monsell, 2014). Here we examined the relative timing of the ERP switch-related positivity and the re-orienting indexed by the latency of fixation on the relevant region. Analyses of ERPs and fixation latencies revealed that re-orienting attention, even when late, preceded the onset of the ERP positivity, and that the ERP positivity was time-locked to the fixation onset more than to the task cue onset. This supports a serial, bi-/multistage, model of TSR and suggests that reconfiguration processes reflected by the positivity occur after, but are temporally tightly coupled to, the re-orientation of spatial attention.

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ANDALUCIA I & II ROOM,

FRIDAY 6TH MAY, 8:00-10:00

### TS06 Animal Learning & Cognition

#### The Stimulus Comparison Process in Rats Perceptual Learning.

ISABEL DE BRUGADA, SERGIO RECIO, ADELA F. ILIESCU, *Universidad de Granada*, ROB HONEY, *University of Cardiff*.

Perceptual Learning refers to a phenomenon that occurs when discrimination between two similar stimuli is facilitated by prior experience with those stimuli. This phenomenon has been studied using both human and non-human subjects. Findings from studies with human subjects suggest that stimulus comparison is critical for perceptual learning. However, when animals are used as subjects, the standard procedure that is routinely used does not favor stimulus comparison, and when manipulations are put in place in order to aid comparison, the results are rather ambiguous. Indeed, in a recent review of this issue, Mitchell and Hall (2014) concluded that the difference in the ability to benefit from the opportunity to compare stimuli could constitute an important difference between the perceptual learning phenomenon studied in human and non-human animals. We present a series of experiments with rats as subjects with a taste aversion paradigm and using a procedure of exposure to stimuli in rapid alternation, similar to the procedure commonly used with humans, to facilitate the comparison process. The result

shows that the comparison process also plays a role with rats as subjects and, as with humans, manipulating the conditions that allow the comparison, as introducing a distraction between stimuli to compare, results in a worse subsequent discrimination. This finding suggests that the discrepancies between the results obtained with human and non-human animals could be due to procedural differences and that the basic perceptual and learning mechanisms are general for both cases. Mitchell, C., & Hall, G. (2014). Can theories of animal discrimination explain perceptual learning in humans? *Psychological Bulletin*, 140(1), 283–307. \*Supported by research project PSI2012-31641 (MINECO, Spain).

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#### A Method for Resolving Occlusions When Multitracking Individuals in a Shoal.

RUTH DOLADO, ELISABET GIMENO, FRANCESC S. BELTRAN, VICENÇ QUERA, *University of Barcelona*, JOSÉ F. PERTUSA, *University of Valencia*.

Studying the collective behavior of fishes often requires tracking a great number of individuals. When many fishes move together, it is common for individuals to move so close to each other that some fishes superimpose themselves on others during one or several units of time, which impacts on tracking accuracy (i.e. loss of fish trajectories, interchange of fish identities). Type 1 occlusions arise when two fishes swim so near each other that they look like one long fish, whereas type 2 occlusions occur when the fishes' trajectories cross to create a T- or X-shaped individual. We propose an image processing method for resolving these types of occlusions when multitracking shoals in two dimensions. We assessed processing effectiveness after videorecording shoals of 20 and 40 individuals of two species that exhibit different shoal styles: zebrafish (*Danio rerio*) and black neon tetras (*Hyphessobrycon herbertaxelrodi*). Results show that, although the number of occlusions depended on both the number of individuals and the species, the method is able to effectively resolve a great deal of occlusions, irrespective of the species and the number of individuals. It also produces images that can be used in a multitracking system to detect individual fish trajectories. Compared to other methods, our approach makes it possible to study shoals with water depths similar to those seen in the natural conditions of the two species studied.

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#### m-Kaku: An Agent-Based Model for the Emergence of Seasonal Fission-Fusion Dynamics.

RUTH DOLADO, FRANCESC S. BELTRAN, ELISABET GIMENO, VICENÇ QUERA, *University of Barcelona*.

For group living primates, social organization hinges upon multiple factors including group size, group cohesion, and the age and sex composition of the group. Fission-fusion dynamics reduce the costs of living in a large group such as feeding competition related to seasonality of resources. Although it is not currently a common approach, some incipient agent-based simulations have been used in order to define the emergence patterns of fission-fusion dynamics in primates depending on ecological constrictions. We have developed *m-Kaku*, an agent-based model and software where dyadic social interaction between agents allows the emergence of fission-fusion dynamics and predicts social organization patterns in Cercopithecidae. We assessed *m-Kaku* model effectiveness comparing simulations results with empirical data obtained from



a group of free red-capped mangabeys (*Cercocebus torquatus*) located close to Loango National Park in Gabon. Results show that *m-Kaku* agent-based model reproduces fission-fusion dynamics observed at field works. Fission-fusion dynamics can be explained by feeding strategies adopted by agents depending on seasonal resource availability. Moreover, we present a software tool that may predict social organization patterns in red-capped mangabeys groups, in order to contribute decisively in the preservation of endangered communities of this species.

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### **Ambiguity Boosts Subsequent Learning about Time and Space in Rats.**

JOSÉ E. CALLEJAS-AGUILERA, JOSÉ A. ALCALÁ, JOSÉ A. ARISTIZABAL, JUAN M. ROSAS, *Universidad de Jaén*.

Attentional Theory of Context Processing (ATCP) focuses on the role of attention on contextual modulation of learning and retrieval of information. According to this theory, context-switch effects would depend on the attention contexts receive, and this attention would be boosted by the ambiguity on the information presented to the organism. Following up with this basic idea, if ambiguity favors learning about context, it might seem reasonable to think that it might as well affect boosts other kinds of learning. The main goal of the experiments presented here was to evaluate whether temporal conditioning (in a Skinner box) and spatial learning (in a water-maze) in rats is improved when it is preceded by an interference treatment that uses different cues within the same situation with respect to different controls that did not receive the interference treatment. Results of these two experimental series show that both, temporal conditioning and spatial learning are facilitated by the ambiguity produced by different interference treatments, suggesting that the role of ambiguity on information processing goes beyond the assumptions of ATCP. The implications of these results for theories of context processing are discussed.

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### **Response-Food Delay Gradients Concurrently Assessed for Several Schedule-Induced Behaviors.**

PEDRO VIDAL, VALERIA E. GUTIÉRREZ-FERRE, RICARDO PELLÓN, *UNED*.

Male Wistar rats maintained at 80-85% of their free-feeding weights by food restriction were submitted to a fixed time 60-sec food delivery schedule until they reached stable rates of spout licking, wheel running and magazine entering. Animals then received a protective contingency by which food was postponed if they licked, run or entered into the magazine during the last 1, 3, 5, 10, 20, 40 or 58 sec of inter-food intervals in successive phases of the study. For half of the rats delays were signaled by tone and blackout, for the other half delays were unsignaled. In a final phase delays were removed. Behaviors were affected by protective delays differentially dependent on their temporal location within inter-food intervals, being licks more resistant to the disruptive effects of delays, followed by running and then magazine entering. Wheel running appears to depend also on its reinforcing properties given the relative limitation of mobility in the rats' home cages. All rates increased when delays were removed. No significant differences were observed when compared signaled and unsignaled delays, except for licking that was somehow more resistant under the signal condition. The introduction of contingent delays upon

responding allows the drawing of response-reinforcer gradients that supposedly reflect the effect of operant contingencies over the responses, showing different sensitivities as a function of their temporal location within inter-food intervals.

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## **MACHADO ROOM, FRIDAY 6TH MAY, 8:20-10:00 TS07 Memory I**

### **Recognition-Induced Forgetting of Visual Objects.**

ASHLEIGH M. MAXCEY, *Tennessee State University*.

In this presentation, I will discuss a paradigm we have developed to look at recognition-induced forgetting of visual objects. Recognition-induced forgetting occurs when practice recognizing an object, from a group of objects learned at the same time, leads to worse memory for objects from that group that were not practiced. This forgetting effect is commonly accompanied by improved memory for practiced objects. We have shown that recognition-induced forgetting is not an artifact of category-based set size. We have also shown that cathodal transcranial direct-current stimulation to DLPFC eliminates forgetting, suggesting a role of inhibitory mechanisms in this forgetting phenomenon. I will discuss our developmental work showing this forgetting effect comes online by 6 years of age without a memory benefit for practiced objects until 9 years of age. Further, the forgetting appears to remain robust with healthy aging in samples of older adults, without the benefit for practiced objects shown in young adults but accompanied by a decrease in intrusion errors. I will conclude by discussing our use of this paradigm to understand how this forgetting phenomenon operates on temporally clustered objects, memory for logos in an applied setting, and the effect of difficult intervening tasks on forgetting. Advantages of this paradigm include that it is possible to test memory of young children using visual objects before they can read, it allows for testing of multiple types of stimuli, and it can be used with animal models. Email: Ashleigh Maxcey, [amaxcey@tnstate.edu](mailto:amaxcey@tnstate.edu)

### **On Testing the Strength Independence Assumption in Retrieval-Induced Forgetting.**

JEROEN RAAIJMAKERS, *University of Amsterdam*.

Strength independence refers to the assumption that in a retrieval induced forgetting paradigm the increase in performance for the practiced items (RP+) is independent of the decrease for the related and supposedly inhibited items (RP-). One way in which this assumption has been tested is by examining the correlation over subjects between these two measures. The finding that there is no such correlation has been taken as evidence for the inhibition account and against non-inhibitory accounts of retrieval induced forgetting. We report several large-scale simulation studies using a simplified version of the SAM model (Raaijmakers & Shiffrin, 1981). The results clearly show that such a non-inhibitory model is not likely to predict a significant correlation, despite the fact that on the level of the predicted probabilities such a correlation is clearly present. Additional simulations show that this is a very general result and not specifically related to the SAM model that

was used. We conclude that such correlations do not provide a good test for the strength independence assumption and will not be able to distinguish between inhibitory and non-inhibitory explanations of retrieval induced forgetting.

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### Modality-Specific Retrieval-Induced Forgetting In Motor Memory.

TOBIAS TEMPEL, CHRISTIAN FRINGS, *University of Trier*.

We examined the impact of matching retrieval modality at retrieval practice and at test on retrieval-induced forgetting of motor sequences. Participants learned sequential finger movements to be performed either with the left or with the right hand. Subsequently, they selectively retrieval-practiced half the items of one hand. A final recall test then assessed memory for all initially learned items. We contrasted different retrieval modalities. In Experiment 1, retrieval practice was motoric in one experimental condition but non-motoric in another condition. The final recall test was motoric in both conditions. In Experiment 2, retrieval practice was always non-motoric but the final recall test was either motoric or non-motoric. Thus, both experiments compared a condition with matching retrieval modality to a condition with non-matching retrieval modality. Retrieval-induced forgetting emerged only when the modality of the final recall test matched the modality of retrieval practice. These findings may imply that retrieval-induced forgetting occurred as a consequence of modality-specific interference that was resolved by modality-specific inhibition.

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### Action Coordination And Prospective Memory: Intention Fulfillment Requires Ongoing-Task Interruption.

JAN RUMMEL, *Heidelberg University*, ANN-KATRIN WESSLEIN, *University of Trier*, THORSTEN MEISER, *University of Mannheim*.

Recent microstructure models of prospective memory postulate three stages of successful fulfillment of event-based intentions. That is, (1) the event must be noticed, (2) the intention must be retrieved from memory, and (3) the intended action must be coordinated with the demands of the currently ongoing task (cf. Marsh, Hicks, & Watson, 2002). Whereas the cognitive processes at work on Stages 1 and 2 are quite well understood, Stage-3 processes have not yet been extensively studied. Therefore, we conducted three experiments where we manipulated the response congruency between the ongoing and the prospective-memory task to investigate Stage-3 processes. In all three experiments, we found intention fulfillment to be less likely when responses were incongruent rather than congruent. This effect was independent of the saliency of the prospective-memory target event (Experiment 1) and of ongoing-task demands (Experiment 2). Importantly, results of Experiment 3 showed that intention fulfillment was more likely in the response-congruent than in a standard condition where ongoing-task and prospective-memory responses were not related. Intention fulfillment in the response-incongruent condition, however, was comparable to standard conditions. These findings demonstrate ongoing-task-interruption processes are distinguishable from cue-noticing (Stage 1) and intention-retrieval (Stage 2) processes and that the necessity to interrupt the ongoing task, that is present in standard prospective-memory situations, puts additional cognitive demands on the individual fulfilling pending intentions.

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### Predicting Prospective Memory Performance from Variations of Attention: A Hierarchical Model Analysis of Prospective Memory and Time Costs.

THORSTEN MEISER, MERLE A. STEINWASCHER, *University of Mannheim*, JAN RUMMEL, *Heidelberg University*.

Previous studies have shown substantial correlations of event-based prospective memory (PM) performance with time costs in an ongoing task. These correlations were computed on the basis of interindividual differences in PM success rates and average reaction times across the ongoing task, where the latter are taken as a measure of attention to the PM task. Interindividual correlations are prone to artifacts due to third variables, however, and do not allow conclusions on the cognitive processes that lead to a correct PM response versus missing a PM cue in a given trial of the PM task. We therefore analyzed PM performance in single trials as a function of intraindividual variations in attention with generalized hierarchical models. In two experiments, we used changes of reaction times to predict the probability of a successful PM response in a subsequent trial. In Experiment 1, we combined the hierarchical analysis of prospective memory and time costs with a manipulation of cue focality. Intraindividual variations in reaction times predicted performance in the next PM trial in the case of non-focal PM cues but not focal PM cues. In Experiment 2, a manipulation of context was used that indicated whether the PM response has to be fulfilled or withheld. Intraindividual changes in reaction times were predictive of correct PM responses but not of false PM responses. Together, the hierarchical analysis showed that intraindividual changes of attention contribute to PM performance in resource-demanding PM tasks but not in situations where PM responses are triggered by spontaneous processes.

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FALLA ROOM,  
FRIDAY 6TH MAY, 11:00-12:40  
**TS08 Letter-Word Processing II**

### Comparing Misses in Letter Detection and Reading Aloud.

ALICE F. HEALY, TESSA K. ZANGARA, *University of Colorado*.

This study aimed to compare two tasks: the standard letter detection task and a novel reading aloud task. In letter detection, subjects silently read passages viewed as a paragraph on paper and circled instances of the target letter *e*. In reading aloud, they read aloud the same passages viewed on a computer screen shown two words per line. There were four different passages, all of which included unrelated sentences, each containing one test word. The passages differed only in the text type (prose, scrambled words) and in the identity of the test word (*the*, *one*). The word *the* is a common function word, whereas *one* is a less common content word. In reading aloud, the test word was repeated in half of the sentences at the end of one line and at the start of the next line. More misses in letter detection occurred on *the* than on *one*, with no difference between prose and scrambled words. In contrast, many more misses in reading aloud occurred on *the* than on *one*,





with a much higher error rate on prose than on scrambled words; almost all misses involved repeated words. These results were explained by proposing that letter detection and reading aloud are primarily influenced by different processes within the Guidance-Organization (GO) Model of reading. Specifically, it is concluded that letter detection is influenced more by pre-lexical unitization processes, which are sensitive to word frequency, and reading aloud is influenced more by post-lexical structural processes, which are sensitive to word function.

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### Are Irregular and Inconsistent English Words Predictable?

ANASTASIA ULICHEVA, *University of Hong Kong*, MAX COLTHEART, *Macquarie University*.

A body that is pronounced in different ways in different words is inconsistent. However, when we take the unit that precedes the vowel into account for the calculation of body-consistency, the inconsistency is reduced at the level of corpus analysis, prompting the question of whether humans actually use such head-/onset- conditioning when they read. Four metrics for head-/onset-constrained body-consistency were calculated: by the last grapheme, by the last phoneme, by place and manner of articulation of the last phoneme, by manner of articulation of the last phoneme. Since these were highly correlated, principal component analysis was performed on them. Two out of four resulting principal components explained significant variance in the ELP data, beyond regularity and traditional body-consistency. This means that humans read head-/onset-conditioned words faster than would be predicted based on their body-consistency and regularity only. We conclude that humans are sensitive to the dependency between word-beginnings and word-ends when they read aloud, and that this dependency is phonological in nature, rather than orthographic.

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### Decomposition in a Non-Concatenated Morphological Structure: Not Only the Roots.

AVITAL DEUTSCH, TAMAR MICHALI, *The Hebrew University of Jerusalem*.

Hebrew words are composed of two non-concatenated morphemes: a consonantal *root* embedded within a *nominal* or a *verbal-pattern* morpho-phonological unit. Research on written word perception has revealed a robust effect of the roots and the verbal-patterns, *but not* the nominal-patterns on word's recognition. These findings suggest that the Hebrew lexicon is organized and accessed via root units. However, the absence of a nominal-pattern effect creates theoretical difficulties for describing the extraction of the root morphemes. We explored the hypothesis that the potential facilitative effect induced by a shared nominal-pattern was annulled in previous studies by an interference effect induced by the competition between the roots of two words derived from different roots but with the same nominal-pattern. A fast-priming paradigm was used, in which target words are embedded in sentences in places that are initially occupied by a random letter string. While the eyes move into the target space, the random string is changed into the prime, which consist of the nominal-pattern letters, whereas the root letters are replaced by dashes. After a brief SOA the prime is changed into the target. This procedure makes it possible to isolate the initial influence of nominal-patterns on lexical access. The results, based

on eye-fixation latency, demonstrated a facilitatory effect induced by nominal-pattern primes relative to orthographic control primes when presented for 33 ms, but not for 42 ms. The results are discussed in relation to the role of the word-pattern as an organizing principle of the Hebrew lexicon, together with the roots.

### A Hierarchical Generative Model of Letter Perception Based on Recycling of Natural Image Features.

MARCO ZORZI, ALBERTO TESTOLIN, *University of Padova*, IVILIN STOIANOV, *CNRS & Aix-Marseille Université*.

In the present study we developed a large-scale connectionist model that learns to recognize letters presented as real images in a variety of fonts, styles, sizes and spatial alignments. The model is based on a stochastic recurrent neural network with many layers of hidden neurons (a "deep network"), which builds a hierarchy of progressively more complex distributed representations of the sensory input by fitting a hierarchical generative model. Crucially, earlier processing levels in the model exploit the recycling of domain-general visual features that are learned through the exposure to patches of natural images. Accordingly, the first layer of neurons develops receptive fields that efficiently encode natural image statistics (e.g., Gabor filters). Domain-specific feature detectors resembling abstract letters emerge in deeper layers through unsupervised learning on a sample of letter images, thereby yielding robust and invariant letter recognition. We validated the model by comparing its performance with published studies on human subjects. In particular, confusion errors produced by the network under noisy conditions are compared with confusion matrices derived from seven empirical studies. We also tested recognition accuracy under different types of band-pass spatial filtering. We conclude that the statistical information extracted from natural scenes can be readily re-used to represent visual symbols like those used in writing systems, and that learning to recognize them only requires a simple, domain- and culture-specific tuning. These results also support the hypothesis that the shapes of written symbols have been culturally selected to match the statistical structure found in natural environments.

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### The Locus of Letter-Specific Position Coding Mechanisms.

STEPHANIE MASSOL, *Basque Center on Cognition Brain and Language and Université de Nîmes*, MANUEL CARREIRAS, *Basque Center on Cognition Brain and Language and IKERBASQUE*, JONATHAN GRAINGER, *CNRS and Aix-Marseille University*, JON ANDONI DUNABEITIA, *Basque Center on Cognition Brain and Language*.

The perceptual matching paradigm was used to investigate whether transposed-character effects can be modulated by the location of the to-be-compared stimulus strings. Stimuli were strings of consonants, digits, or symbols. Reference and target stimuli were identical or differed either by transposing or substituting two characters. The reference was always presented at the center of the screen. Half of the targets were displayed at the center of the screen and the other half were shifted by two character positions to the left or to the right, and in all cases one line below the reference stimulus. Error rates and d-prime analyses revealed that transposed-character effects were larger for letter strings than for both digit

and symbol strings. Most importantly, the displacement caused an increase in transposition costs whatever the type of character. We argue that differences in reference and target location along the horizontal meridian interferes with the mapping of retinotopic features onto object-centered representations of character strings, and that same-different judgments are based on activity in these location-invariant object-centered representations. Moreover, letter position information is encoded differently at this level of processing compared with the position of characters in other kinds of strings, hence accounting for the pattern of transposition effects seen for the different types of stimulus.

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## ANDALUCIA I & II ROOM, FRIDAY 6TH MAY, 11:00-12:40 TS09 Embodied Cognition

### A Meta-Analysis of Temperature-Behaviour Effects in Experimental Studies.

DERMOT LYNOTT, *Lancaster University*, KATHERINE CORKER, *Kenyon College*, LOUISE CONNELL, *Lancaster University*, KERRY O'BRIEN, *Monash University*.

The surrounding environment has a profound impact on human behaviour. Research from field and population-based studies have shown that higher temperatures are associated with increases in antisocial behaviours, including aggressive, violent, or sabotaging behaviours. More recently, there have been many demonstrations from experimental studies in social embodied cognition showing that higher temperature experiences might also be linked to increases in prosocial behaviours, such as altruistic, sharing or co-operative behaviours. However, in both domains, studies have failed to replicate key temperature-behaviour predictions, leaving the status of these links unclear. Here we conduct a series of meta-analyses of available laboratory-based empirical studies that have either prosocial (e.g., monetary reward, gift giving, helping behaviour) or antisocial (retaliatory behaviour, horn honking, sabotage) outcome variables, with temperature as an independent variable. In an omnibus analysis, we found that there was no reliable effect of temperature on the behavioural outcomes measured. Furthermore, there was no effect of temperature on prosocial or antisocial outcomes when analysed separately. We find that the evidence to support temperature-behaviour links from laboratory-based studies is weak. Future work will consider how these patterns can be reconciled with field and population-based studies that have consistently found associations between temperature and behavioural outcomes.

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### The Effects of Emotional Facial Expression of Happiness and Sadness on Time Perception in Patients with Parkinson's Disease.

GIOVANNA MIONI, *University of Padova*, SIMON GRONDIN, *Laval University*, FRANCA STABLUM, *University of Padova*.

Objective: Previous studies have demonstrated that emotional facial expressions alter temporal judgments. Moreover, while some studies conducted with Parkinson's Disease (PD) patients suggest dysfunction in the recognition of emotional facial expression, others have shown a dysfunction in time perception. In the present study, we investigate the magnitude of temporal distortions caused by the presentation of emotional facial expressions (happiness, sadness, and neutral) in PD patients and controls. Method: Twenty older adults with PD and 20 healthy older adults took part in the present study. PD patients were divided into two sub-groups, with and without mild cognitive impairment (MCI), based on their neuropsychological performance. Participants were tested with a time bisection task with standard intervals lasting 400 ms and 1600 ms. Results: The effect of facial emotional stimuli on time perception was evident in all participants, yet the effect was greater for PD-MCI patients. Further, PD-MCI patients were more likely to underestimate long and overestimate short temporal intervals than PD-non-MCI patients and controls. Conclusions: Temporal dysfunction in PD-MCI patients is discussed in terms of memory dysfunction.

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### New Response Patterns in Point-To-Origin Tasks Depending On Stimulus Type and Response Mode.

BERNHARD E. RIECKE, EKATERINA R. STEPANOVA, ALEXANDRA KITSON, *Simon Fraser University*.

We used an online point-to-origin tasks to investigate potential influences of stimulus type (video vs. textual) and response format (textual vs. pictogram multiple choice answers). Using an online survey tool, participants (N=124) either saw a simulated 2-segment outbound path (two straight segments with a 60° or 90° turn in-between) or a textual description thereof. At the path end, participants chose one out of four options that best describes the direction to the starting point. Options were either textual (e.g., "back left") or pictorial using a schematic top-down view (hypothesized to trigger a more embodied response). As expected, we observed both "turner" (participants responding as if successfully updating heading and movement) and "non-turner" responses (responding as if failing to update heading). Unexpectedly, we observed two additional response patterns, which we termed "spinner" (responded as if they turned 180° at the end of the trajectory before pointing) and "non-mover" (responded as if pointing from the origin of motion to the end location). The embodied response condition yielded more "non-turners" than textual condition, as predicted by the increased reference frame conflict between to-be-imagined and physical orientation. Surprisingly, text-text conditions elicited a significant number of "non-movers" ( $p < 0.001$ ), suggesting interference between text comprehension and imaginary navigation; while in video-pictogram conditions we observed many "spinner" responses ( $p < 0.01$ ). Our data suggests that presentation and respond modes reveal additional strategies used in point-to-origin tasks, which cannot be explained through the failure to update the heading solely. Further research on the origins and distribution of different strategies is required.

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### **Gestalt Reasoning: Perceptual Compatibility Effects Evoked By Coordination Descriptions.**

MAGDA L. DUMITRU, *METU*, GITTE H. JOERGENSEN, *University of Connecticut*.

**Introduction:** When processing complex information, individuals often forego reasoning rules and draw on general cognitive mechanisms instead. Accordingly, their responses may vary with stimuli perceptual properties, with mental models, or with metaphors grounding available information onto basic action patterns. We investigated how validation scores of conjunction and disjunction descriptions vary with stimuli perceptual properties. We hypothesised that high scores would obtain for conjunctions describing perceptually-dependent stimuli and for disjunctions describing perceptually-independent stimuli, where dependency status followed key Gestalt principles.

**Methods:** In each of three studies ( $N = 20$ ) participants determined whether a coordination description matched a visual display. In Experiment 1, dependent and independent stimuli were moving simultaneously, respectively alternatively, illustrating the principle of common fate. In Experiment 2, dependent and independent stimuli were placed close, respectively far from each other, illustrating the principle of proximity. In Experiment 3, dependent and independent stimuli were of similar, respectively of dissimilar shapes, illustrating the principle of similarity.

**Results:** A comparison of effect sizes confirmed our perceptual-dependency hypothesis. Moreover, the results showed that Gestalt grouping is strongest for stimuli varying in motion type, weaker for stimuli varying in spatial placement, and weakest for stimuli varying in shape.

**Conclusions:** Our studies assessed the independent effects of motion type, proximity, and similarity, thereby contributing to the current debate concerning the representations evoked by naïve reasoning (i.e., model-, metaphor-, or Gestalt-based).

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### **Do Taller People Think More Abstractly? A Test of the Body-Specificity Hypothesis.**

DANIEL CASASANTO, CHÉ LUCERO, AMANDA DOBBYN, *University of Chicago*. According to the body-specificity hypothesis, people with different kinds of bodies interact with their environment differently, and should therefore think differently in predictable ways. In a test of this hypothesis we investigated whether taller people, who view things from a greater height than shorter people, think more abstractly as a consequence. Previous experiments suggest that briefly experiencing higher physical elevation (e.g., ascending a staircase) leads people to construe events at a “higher,” more abstract level, whereas experiencing lower elevation (e.g., descending a staircase) leads to lower-level, more concrete construal. We reasoned that habitually experiencing higher or lower elevation due to one’s body height could have similar consequences. Participants ( $N=481$ ) answered questions from a standard test of concrete vs. abstract construal (e.g., whether “toothbrushing” is best described as “moving a brush around in one’s mouth” or “preventing tooth decay”) and then reported their height and other demographics. As predicted, taller people construed the same events significantly more abstractly than shorter people. The relationship between height and construal level remained significant when effects of sex and race (both height-correlated) were controlled. On average, men construed events significantly more abstractly than women; this effect was abolished

when the effect of height was controlled, suggesting that height was at least partly responsible for the observed sex difference. In summary, taller people, who habitually enjoy more of a bird’s-eye view than shorter people, also tend to construe events more abstractly, revealing a previously undiscovered way in which people with different kinds of bodies think differently.

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### **ANDALUCIA III ROOM, FRIDAY 6TH MAY, 11:00-12:40 TS10 Spatial Cognition**

#### **Single-Destination Navigation in a Multiple-Destination Task: A New “Later-Destination Attractor” Bias In Route Choice.**

EN FU, BEVERLY ROSKOS, *University of Alabama*, MARY BRAVO, *Rutgers University*.

People choose different routes depending on the size of the environment. However, the size of the environment is often confounded by cognitive load. The current study investigated, through a small-room navigation task, whether route choice varied as a function of memory load. Also, a new experimental focus was introduced: route choice to a single destination as a function of the location of later destinations. Critically, there were two routes of equal length to the first destination. The results showed that route choice to the first destination was influenced by the locations of later destinations. This (new) “later-destination attractor” bias is the tendency to take a route to the first destination that begins in the direction of later destinations even when the route to the first destination is logically independent of the locations of later destinations. In Experiment 1 all destinations were visible, and the bias was seen for two-destination tasks and three-destination tasks. Experiments 2 and 3 showed that the extent of the bias was reduced as memory load increased. Experiment 4 replicated Experiment 1 in a virtual environment and the same bias was observed. Indications are that differences in route choice between small- and large-scale environments may be due more to cognitive load than environmental size.

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#### **Deadlines in Space: Selective Effects of Coordinate Spatial Processing in Multitasking.**

TIMO MÄNTYLÄ, IVO TODOROV, VEIT KUBIK, *Stockholm University*, FABIO DEL MISSIER, *University of Trieste and Stockholm University*.

Many everyday activities require coordination and monitoring of multiple deadlines. One way to handle these temporal demands might be to represent future goals and deadlines as a pattern of spatial relations. We examined the hypothesis that spatial ability, in addition to executive functioning, contributes to individual differences in multitasking. Participants completed a multitasking session in which they monitored four digital clocks running at different rates. We predicted and found that individual differences in spatial ability and executive functions were independent predictors of multiple-task performance. Individual differences in spatial ability were also selectively related to multiple-task performance, as only coordinate spatial processing, but not categorical, predicted

multitasking, even beyond executive functioning and numeracy. Furthermore, males outperformed females in spatial ability and multitasking and these sex differences generalized to a complex simulation of everyday multitasking. Menstrual changes moderated these effects in that sex differences in coordinate spatial processing and multitasking were observed between males and females in the luteal phase of the menstrual cycle, but not between males and females at menses. Overall, these findings suggest that multiple-task performance reflects independent contributions of spatial ability and executive functioning. Furthermore, our results support the distinction of categorical vs. coordinate spatial processing, and suggest that these two basic relational processes are selectively affected by female sex hormones and differentially effective in transforming and handling temporal patterns as spatial relations in the context of multitasking.

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### Spatial Interference on Temporal Judgments: Effect of Depth in Children and Adults.

POM CHARRAS, *University of Paul Valéry – Montpellier*, SYLVIE DROIT-VOLET, *University of Clermont-Ferrand*, CLAIRE BRECHET, *University of Paul Valéry – Montpellier*, JENNIFER COULL, *CNRS – UMR 7291 – Marseille*.

Adults are capable of precisely perceiving durations in the range of several milliseconds to seconds. More strikingly, timing ability is functional at an early age in children. However, temporal judgments are fragile and are affected by a wide variety of factors, such as spatial context. The longer the distance a stimulus covers (the “distance effect”), or the further it is perceived to be from the observer (the “depth” effect), the longer its duration is perceived to be. The present study aimed to investigate how depth cues influenced perceived duration of stimuli travelling in either the lateral or frontal axis, in both children (age 5-10 years) and adults ( $n=79$ ). In one experimental session, stimuli moved in the lateral axis, either near or far from the point of view of the observer. In the other session, stimuli moved in the frontal axis, either looming towards or receding from the observer. The findings indicate that children show significant depth effects, similar to those previously reported in adults. Moreover, both adults and children show reliable distance effects in both axes. To our knowledge, this is the first piece of evidence that the time-space interaction characterized by the distance effect is present in the frontal axis (looming and receding trajectories). Importantly, despite a general lower accuracy for the youngest children, the size of distance effect was similar across the four age groups, suggesting that time-space interactions are mature and functional from the age of 5.

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### Generalizing Effects of Types of Low Vision and Age on Spatial Learning While Navigating.

KRISTINA M. RAND, ERICA M. BARHORST, WILLIAM B. THOMPSON, SARAH H. CREEM-REGEHR, *University of Utah*. Impaired spatial learning during navigation with simulated degraded acuity and contrast sensitivity can be attributed not only to reduced visual information available to the actor, but also to the increased cognitive resources required to navigate independently while visually impaired (Rand, Creem-Regehr, & Thompson, 2015). To further investigate the roles of both sensory and cognitive effects we conducted a series of studies aimed to test whether the low vision

effects on spatial learning generalize across different types of visual impairment and to older adults. Participants were instructed to remember target locations as they navigated novel real-world paths. Concurrently, they performed a secondary auditory task measuring response time to tones to measure cognitive load. At the end of each path, they pointed to remembered target locations to assess survey spatial learning. Participants were tested with simulated low vision, either severely reduced acuity and contrast sensitivity or severely reduced peripheral field (manipulated between subjects) and all completed a normally-sighted control condition to allow for a within-subject comparison. We also tested two age groups: younger adults (ages 18-35) and healthy older adults (ages 60-80). Results suggest similar decrements in spatial learning across different simulated degraded viewing conditions and across age groups when compared to control viewing conditions. We will discuss these results in the context of theories of attentional demands during navigation with visual impairment, and the different possible reasons for increased cognitive load that occur with reduced acuity/contrast sensitivity, peripheral field loss, or normal aging.

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### Integrating Spatial Information across Experiences.

MARIOS AVRAAMIDES, *University of Cyprus*.

In the course of their everyday life, people move around in their environment and often experience the same space from different viewpoints at different points in time (e.g., when entering a park from different entrances across different visits). A question that arises is whether people readily integrate new spatial locations into an existing representation at the time of encoding, or whether they store each unique episodic experience as a separate representation in memory, relating information across layouts only when a task requires them to do so. I will present results from a series of experiments targeting this question by examining the retrieval of spatial locations experienced in the same enclosing space at different points in time. These experiments involved studying the locations of two layouts of objects from the same or different viewpoints and then carrying out a series of perspective-taking trials (i.e., imagine facing  $x$ , point to  $y$ ; where  $x$  and  $y$  are memorized objects) that required information from one or both layouts. Comparing performance for within- and between-layout trials allows determining whether locations are integrated into a single representation at the time of encoding. Findings across several experiments converge in that integration is a flexible process with people keeping spatial information in separate representations when integration at learning is cognitively demanding (e.g., when studying layouts from different perspectives and in the absence of a stable environmental reference frame). Overall, findings provide insights on the factors that determine when integration of spatial information across experiences takes place.

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FALLA ROOM,  
FRIDAY 6TH MAY, 15:20-17:00  
**TS11 Language Processing I**

**Imaging Imageability: Neural Correlates of its Interaction with Affect and Context.**

CHRIS F. WESTBURY, JACQUELINE CUMMINE, *University of Alberta*.

The construct of imageability refers to the extent to which a word evokes a tangible sensation. We follow-up on previous research (Westbury, Shaoul, Hollis, Smithson, Briesemeister, Hofmann, & Jacobs, 2013) suggesting that the behavioral effects attributed to a word's imageability, as subjectively judged by humans on a 7-point scale, can be largely or wholly explained by two objective constructs, co-occurrence density and estimated emotionality. In particular, we extend Westbury et al.'s previous findings in two ways, first by showing that closely matching stimuli on all three measures shows a three-way interaction in explaining variance in lexical decision RTs, and secondly, by demonstrating that the loci and degree of BOLD activation implicated in processing the three variables during that task are almost perfectly over-lapping. These two lines of evidence lend further support to the claim that the effect usually attributed to imageability is largely or entirely due to other correlated differences.

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**When the Container Affects the Content: Semantic Priming Vanishes for Foreign-Accented Speakers.**

CARLOS ROMERO-RIVAS, ALBERT COSTA, *Universitat Pompeu Fabra*.

Semantic priming is used as a tool to understand the organization of the mental lexicon. Activating semantic features of the primes ('doctor') facilitates the processing of semantically related ('nurse') compared to unrelated targets ('bread'). However, it still remains unknown whether semantic relationships are established automatically or, on the other hand, if they depend on contextual information present during word learning and daily exposure to language. In this study, we used ERPs to explore whether specific acoustic features of speech (native vs. foreign accents) have an impact on the way words are stored and organized in the lexicon. More concretely, we presented a Spanish sample of adults (N = 23) with auditory primes spoken either by a native Spanish or by a French speaker of Spanish (mild and common accent). We observed semantic priming (reduced N400 ERP for related than unrelated targets) for high and low-frequency primes spoken by the Spanish native speaker. However, we only observed semantic priming for high-frequency (but not low-frequency) primes spoken by the foreign-accented speaker. In a follow-up ongoing study, we did not observe semantic priming for a German speaker of Spanish (strong and uncommon accent), neither for high nor low-frequency primes. These results suggest that words are stored with specific acoustic properties, and that accessing their semantic features is easier when there is a long-term representation for the word that matches the input signal.

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**Motor Actions Cause Qualitative Changes in Action Language Understanding.**

ANDREA FLUMINI, OMAR ESCÁMEZ, *Universidad de Granada*, GABRIELLA VIGLIOCCO, *University College London*, DANIEL CASASANTO, *University of Chicago*, JULIO SANTIAGO, *Universidad de Granada*.

Embodied theories propose that an essential ingredient of language understanding is the detailed mental simulation of the meaning of words and sentences. Yet, there is no evidence that shows that interfering with perceptual and motor areas of the brain changes the meaning that is constructed from the sentence. In the present study we provide such evidence, focusing on action concepts. Action concepts (e.g., "to stomp grapes"), as any other concept, can be construed at different levels, from a low level ("to crush grapes with the feet"), which specifies the perceptual and motor details of the action, to a high level, which focuses on the distant goals of the action ("to make wine"). If motor areas of the brain simulate the lower levels of actions, interfering with them should bias meaning construction toward higher levels. To test this hypothesis we asked participants to judge descriptions of hand or foot actions while performing a repetitive rhythm production task with either their hands or feet. As predicted, motor interference had selective effects on the comprehension of sentences about actions made with the hands versus feet, causing same-effector actions to be construed at a higher level. These results support a causal role of the motor system in sentence comprehension: interfering with motor simulation causes a qualitative change in readers' understanding of actions. We propose that perceptuo-motor areas of the brain build detailed mental simulations of linguistic content, whereas multimodal integration areas compute higher level construals. Language comprehension is the result of the dynamic balance of these two systems. Email: Julio Santiago, [santiago@ugr.es](mailto:santiago@ugr.es)

**Does Sentential Negation Relies on Action Inhibition Neural Processes? Evidence from Frontal Theta Rhythms.**

MANUEL DE VEGA, INMACULADA LEON, *University of La Laguna*, MANUEL MARTIN-LOECHES, *Center for Human Evolution and Behavior, UCM-ISCIII*, DAVID BELTRAN, YURENA MORERA, *University of La Laguna*, PILAR CASADO, *Center for Human Evolution and Behavior, UCM-ISCIII*.

The current literature on sentential negation provides important information on its behavioral and neural consequences. For instance, negation reduces the accessibility of the concepts under its scope, and when negation is applied to action contents (e.g., I don't write the letter) impedes the activation of motor processes in the brain, inducing "disembodied" representations. However, how negation itself is processed in the brain is still poorly understood. We explored whether sentential negation shares neurophysiological mechanisms with action monitoring or inhibition. Participants read action-related sentences in affirmative or negative form ("now you will cut the bread" vs. "now you will not cut the bread"), while performing a simultaneous Go/NoGo task. The analysis of the EEG rhythms revealed that theta oscillations were significantly reduced for NoGo trials, and delta oscillations increased for Go trials in the context of negative sentences, compared to affirmative sentences. Given the fact that theta and delta oscillations are often considered as neural markers of response inhibition processes, their modulation by negative sentences strongly suggests that negation employs neural resources of response inhibition. We propose a new

approach that views the syntactic operator of negation as relying on the neural machinery of high-order action monitoring processes.  
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### The Nature of Semantic Priming by Subliminal Spatial Words. Embodied or Disembodied?

ROBERTO BOTTINI, *CIMeC University of Trento*, MADALINA BUCUR, *University of Milan-Bicocca*, DAVIDE CREPALDI, *SISSA, Trieste and Milan Center for Neuroscience*. Theories of Embodied Semantics (ES) suggest that a critical part of understanding what a word means consists in the re-instantiation of the sensorimotor experience related to the word's referent. Some proponents of ES have suggested that sensorimotor activations are mandatory and highly automatic during semantic processing. Evidence supporting this claim comes from masked priming studies showing that unconsciously perceived spatial words (e.g. up, down) can directly modulate action performance on the basis of their meaning. However, a closer look reveals that such priming effects can be explained also in terms of symbolic (disembodied) semantic priming or non-semantic stimulus-response mapping. In this study we sought to understand whether sensorimotor processing takes place during language understanding outside awareness. We used spatial words as a test-bed and across six masked priming experiments (N=160) we teased apart the possibility that action priming could be explained by: (i) stimulus-response mapping; (ii) symbolic semantic priming; or (iii) embodied mechanisms. The critical finding is that no priming effect was found when the possibility of symbolic priming was prevented, allowing only for a genuinely embodied effect. Conversely, facilitation emerged in the same experimental paradigm when embodied priming was prevented, and symbolic priming was allowed. Despite extensive test, we found no evidence that unconsciously perceived words can activate sensorimotor processes, although these words are processed up to the semantic level. We thus conclude that sensorimotor activations might need conscious access to emerge during language understanding.

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## ANDALUCIA I & II ROOM, FRIDAY 6TH MAY, 15:20-17:00 TS12 Language Disorders

### Predicting Individual Dyslexia Patterns and Intervention Strategies through Computational Modelling.

JOHANNES C. ZIEGLER, *University Aix-Marseille and CNRS*, MARCO ZORZI, *Università di Padova*, CONRAD PERRY, *Swinburne University of Technology*.

Learning to read in alphabetic languages relies on two core mechanisms: phonological decoding and self-teaching. Here, we present the first full-blown developmentally plausible computational model of reading acquisition that implements these two mechanisms. It was used to simulate developmental trajectories of 622 children (388 dyslexics). We show that individual reading performance on words and nonwords can be simulated with high accuracy on the basis of their underlying deficits in subcomponents of the reading network. Such simulations make it possible to predict

for any given child how remediating one or several subcomponents should improve reading of words and nonwords. We further show that common single-deficit theories are unable to account for the observed heterogeneity in reading performance. We thus advocate a novel multi-factorial computational approach of understanding reading and dyslexia, which has concrete practical implications for intervention..

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### Perception of IDS by Children with Dyslexia.

VICTORIA LEONG, Liana Amunts, USHA GOSWAMI, *University of Cambridge*.

Infant-directed speech ("Motherese") is a natural language-learning device with exaggerated prosodic rhythm. These rhythmic cues are thought to support speech perception by young listeners. Children with dyslexia show impaired rhythm perception, and rhythm sensitivity is related to reading development. However, prosodic sensitivity to IDS has not yet been studied in dyslexia. Here, we assess 16 typically-developing children and 14 age-matched children with dyslexia. The children listened to excerpts from Aesop's short stories, read either in IDS or in adult-directed speech (ADS). After each story, children answered YES/NO questions about semantic or phonological aspects of selected words. The results showed that both groups of children performed better when listening to stories that were read in IDS as compared to stories that were read in ADS. For both groups, the listening benefit from IDS was significantly stronger for questions requiring children to discriminate between semantically-similar words (e.g. "delicious" vs "tasty") as compared to phonologically-similar words (e.g. "tap" vs "lap"). Although children with dyslexia performed more poorly than controls overall, this group difference did not reach significance. Therefore, there was no difference between dyslexic and control children in the *relative* benefit conferred by IDS over ADS. We conclude that IDS confers powerful developmental benefits to young listeners, particularly concerning semantic information in speech. IDS is a form of speech enhancement that even children with developmental language impairments (dyslexia) can benefit from. Accordingly, the use of IDS can potentially enhance oral language-based interventions for children with dyslexia.

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### Parental Speech to Typically and Non-Typically Developing Toddlers.

LUCA ONNIS, *Nanyang Technological University*, ANNA TRUZZI, PAOLA VENUTI, ARIANNA BENTENUTO, GIANLUCA ESPOSITO, *University of Trento*, *Nanyang Technological University*, SHIMON EDELMAN, *Cornell University*.

Parents naturally speak utterances containing partial self-repetitions (e.g., Want to get your ball? Get your ball? Do you want to get your ball?). Such "structured variation" contains cross-utterance statistical cues to the building blocks of language (words, lexical categories such as nouns and verbs, syntactic constructions, word order relations), and is predictive of children's lexical and grammatical structures. Here we compared structural characteristics of maternal language directed to toddlers with Autistic Spectrum Disorders (ASD, n=25), Down Syndrome (DS, n=25), and a control group of Typically Developing toddlers (TD, n=31). We analysed the child-directed transcriptions of child-mother interactions during



naturalistic dyadic play interactions. Under the null hypothesis parental speech should not differ in amount of structured variation, as children's mean developmental age (24.60 months,  $SD=8.31$ ) was the same across the three groups. Instead, we found that the proportion of sentences in sets of structured variation in child-directed speech was significantly the largest for ASD ( $55.3\pm2.8\%$ ), smaller for DS ( $44.9\pm2.2\%$ ), and the smallest for the TD group ( $34.7\pm2.3\%$ ). Because structured variation decreases with chronological age of the child, this finding is even more striking given that ASD, and DS children were on average 2 years (DS) and 3 years older (ASD). Our findings point to mothers' aptitude to tailor language to the special needs of their children, and raise new questions on how maternal structured speech shapes the language development of typically and non-typically developing children.

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### **Inference Generation While Reading in High-Functioning Children and Adolescent with Autism: An Eye Movement Study.**

MARTINA MICAI, *University of Seville*, HOLLY JOSEPH, *University of Reading*, MILA VULCHANOVA, *Norwegian University of Science & Technology*, DAVID SALDAÑA, *University of Seville*.

Previous research suggests that children with autism spectrum disorder (ASD) have problems with inference generation. The aim of this study was to investigate the on-line behaviour during text reading and question answering that does, or does not, require inference generation. High-functioning children and adolescents with ASD ( $n = 22$ ), and typically developing participants (TD) ( $n = 22$ ), matched for chronological age, intelligence scores, language skills, and reading ability, read five stories, each divided into five paragraphs. At the conclusion of each paragraph participants answered an inferential or text-based question. Results showed that ASD were as accurate as TD in responding to inferential and text-based questions, and no differences were found between the two groups in the global paragraph reading and responding time. Analyses of eye movement on the words previously defined as fundamental to question responding showed longer reading time in the inferential condition for the ASD. Additional analyses indicated that accuracy in inferential paragraphs improved for ASD when they spontaneously read the question before the target word; no such pattern was observed in TD. In conclusion, despite similar comprehension behavioural scores and global paragraph reading, ASD exhibit a delay in processing times in the inference condition. Also ASD found benefit in a self-initiated reading strategy where the question was fixated on before the target word.

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ANDALUCIA III ROOM,  
FRIDAY 6TH MAY, 15:20-17:00  
**TS13 Cognitive Control II**

### **Young Children's Attentional Problems Are Predicted by Early Inhibitory Control and Cortisol Stress Reactivity.**

ELIZABETH P. HAYDEN, KATIE R. KRYSKI, HAROON I. SHEIKH, HEATHER J. SMITH, *University of Western Ontario*.

Studies have examined associations between children's hypothalamic-pituitary-adrenal (HPA) axis functioning and attention, although findings are inconsistent across studies. This inconsistency may be due in part to the failure to integrate the HPA axis with other regulatory systems, such as the executive control system. The current study examined the interplay between salivary cortisol responses to stress, inhibitory control, and changes in attentional problems during early childhood. Four hundred and nine three-year-olds from the community completed standardized laboratory tasks designed to elicit cortisol stress reactivity and failures in inhibitory control. Children's parents provided information on children's attentional problems at baseline (child age 3) and two years later (child age 5). Children's cortisol stress reactivity was only related to attentional problems at follow-up when inhibitory control was low. Findings indicate a dynamic relationship between multiple regulatory systems in predicting the development of children's attention.

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### **Influence of Family SES on the Early Development of Executive Attention.**

ÁNGELACONEJERO, SONIAGUERRA, M. ROSARIO RUEDA, *University of Granada*. A growing body of literature shows that socio-economic status (SES) impacts children's executive control efficiency at different levels. Children from low-SES families have poorer performance in executive control tasks, show decreased brain activity while performing those tasks, and show decreased grey matter volume in prefrontal areas of the brain compared to children raised in high-SES families. However, few studies have investigated the impact of SES on the early development of executive attention. In our study, we aimed to address this question from a longitudinal perspective. We recruited 88 infants by the age of 9 months and followed them up at 16, 26 and 36 months of age. Children performed executive attention tasks adapted to the age of testing. We collected behavioral measures (looking time, response accuracy or reaction time) as well as functional brain activity measures. SES was reported by parents through a questionnaire, which provides information on parental education, occupation and income. Consistent with previous studies, we found that low-SES children showed poorer performance in executive attention tasks as early as by 9 months of age, and this was observed up to early childhood. These results inform about the importance of environmental factors on cognitive development from very early on. This information is key to the design of family interventions aimed at promoting the development of self-regulation skills and preventing/palliating the effect of detrimental environment.

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### **A Task Switching Asymmetry in Lexical Decision.**

WALTER GERBINO, PAOLO D'ERRICO, *University of Trieste*, CRISTINA BURANI, *Institute of Cognitive Sciences and Technologies, CNR*.

To evaluate paper-and-pencil versions of the lexical decision task, we ran an experiment focused on two questions: (a) whether performance superiority in the positive task ("mark all words") over the negative ("mark all pseudowords") depends on observer's accuracy; (b) whether performance in a sequence of two tasks



(positive-positive, positive-negative, negative-positive, negative-negative) reflects only practice and task difficulty, or also task switching costs/benefits. We asked four groups of 30 observers each to mark targets (words or pseudowords, depending on task version) rapidly and accurately; two different 48-item lists (24 words and 24 pseudowords) were used for every observer. The experimenter recorded the amount of time needed to complete each task. The overall performance index was the product of execution speed ( $1/t$ ) and a non-parametric measure of sensitivity. Together with a small systematic practice benefit and a large advantage for the positive task, a clear cut task switching asymmetry emerged: performance in the negative task improved when observers had the positive task as the first, whereas performance in the positive task was worse when observers had the negative task as the first. This type of task switching asymmetry provides new evidence about processes involved in the go/no go variant of lexical decision.

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### Predicting the Ability Moment-by-Moment to Avoid Emotional Distraction in Mid-Adolescence.

MARIE T. BANICH, HARRY SMOLKER, TOR D. WAGER, *University of Colorado Boulder*, HANNAH R. SNYDER, BENJAMIN L. HANKIN, DETRE GODINEZ, *Denver University*, JARROD LEWIS-PEACOCK, *University of Texas at Austin*.

This study examined how neural systems influence the ability to ignore distracting emotional information, which is highly salient during mid-adolescence. Teens performed an emotional Stroop task in which they classified the valence of an emotional word (e.g., sad) positioned on a face whose expression could either be congruent or incongruent in valence. Activation in three neural systems was examined to determine their influence on behavioral performance (RT) on a trial-by-trial basis: Perceptual processing (of the word, and of the face respectively as determined via a multi-voxel pattern analysis classifier), emotional salience (via amygdala activity), and cognitive control (via dorsolateral prefrontal cortex (DLPFC) activity). Furthermore, mediation analysis examined the interrelationships of these factors, and moderation analyses examined the influence of individual differences in Executive Control and Negative Affect, as determined by self-report questionnaires. Higher activation of the DLPFC on any given trial was associated with lower perceptual processing of facial information. On incongruent, but not congruent trials, both DLPFC and amygdala activation had a direct effect on reaction time, even when the influence of perceptual processing was considered. Finally, individual differences moderated the effect of face processing on RT, increasing it for individuals higher in Negative Affect and reducing it for individuals higher in Executive Control.

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### Metacognitive Strategies Enhanced the Effect of Attention Training on Brain Activation Related to Cognitive Control in Pre-School Aged Children.

J. PAUL POZUELOS, LINA M. COMBITA, ALICIA ABUNDIS, *Universidad de Granada*, PEDRO M. PAZ-ALONSO, *BCBL*, M. ROSARIO RUEDA, *Universidad de Granada*.

Pre-schoolage children experience a period of mayor development of cognitive control processes. This development is supported by brain plasticity, which promotes maturation and specialization of

the brain networks that underlies this control mechanism. In recent years, there has been a strong interest in studying the influence of cognitive training in the efficiency of these brain networks. Our research aimed at assesses the impact of cognitive training with and without metacognitive scaffolding in measures of brain activation related to cognitive control. A total of 90 children performed a child-friendly version of the Flanker and the Go-NoGo tasks prior to and following 8 sessions of attention training under normal feedback (NF,  $n=20$ ), metacognitive feedback (MF,  $n=25$ ) or control activities (C,  $n=28$ ). Brain activation was measure by EEG recordings. The N450 component, a negative fronto-central component peaking around 450ms after stimulus onset, was used as an index of conflict effect (i.e. incongruent – congruent, and NoGo – Go). Results for the flanker task show that children in the MF training group presented a significant increase of the conflict effect, as well as a change in the topography of the N450. For the Go-NoGo task results indicated that children in the MF group show a significant decrease in latency of the N450, which predicted increases in  $d'$ . These results provide further evidence of cognitive and brain plasticity following training. Also, it shows that training effects can be boosted by including a metacognitive scaffolding aiming to improve the use of abstract representations that supports cognitive control.

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MACHADO ROOM,  
FRIDAY 6TH MAY, 15:20-17:00  
TS14 Development

### Cognitive and Neural Markers of Children's Executive Attention and Reward Processing: Influence of Variation in the SLC6A3/DAT1 Gene.

LINA M. COMBITA, MARIA T. MARTÍNEZ-NAVARRETE, GUSTAVO GIL, M. ROSARIO RUEDA, *Center for Research on Mind, Brain and Behavior (CIMCYC), University of Granada*.

Executive functions exhibit a significant development during childhood and are good predictors for academic success and social wellbeing. Two of the main executive functions known as inhibitory control and cognitive flexibility are supported by the activation of prefrontal structures in the brain. Here, neural activity is strongly influenced by dopaminergic innervations projecting from the striatum, which are also central for the processing of rewards and motivation when projecting to mesolimbic structures. It has been proposed that striatal dopamine mediates the interaction between cognitive control and motivation. Given that the regulation of dopamine levels in the striatum is carried out by the action of dopamine transporters, we investigated how variations of the SLC6A3/DAT1 gene, which have been related to differences in the expression of the gene, influences children's performance on a task that addresses cognitive flexibility and attentional control under different conditions of reward. 36 children (8 to 11 years) performed a modified version of the cognitive flexibility task proposed by Aarts, et al. (2010) while high-density EEG was being recorded. Results show that carriers of the 10r allele, associated to decreased levels of DA in the striatum, exhibit greater interference and reduced cognitive flexibility compared to carriers of the 9r allele. Moreover, children, homozygous for the 10r allele perform





poorly when errors were associated to a greater loss. Our findings suggest that dopamine levels in the striatum not only relate to children's cognitive control but also modulate the impact of reward on the deployment of control resources.

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### **A Neural Marker of Impaired Feature Integration in Visual Face Memory in Developmental Prosopagnosia.**

JOHN TOWLER, MARTIN EIMER, *Birkbeck, University of London.*

Developmental prosopagnosia (DP) is a severe impairment in face recognition despite normal intelligence and low-level vision. It is currently unclear which aspects of short term visual face memory are impaired in DP. To address this question, neurotypical participants and individuals with DP performed a sequential face identity matching task. Two successive face images were presented on each trial. On full repetition and full change trials, two identical or two different faces were shown. On partial repetition trials, internal facial features were repeated while external features changed, or vice versa. Participants had to discriminate full repetitions from partial or full changes across face pairs. EEG was recorded during task performance and the N250r component of the event-related potential was measured as neural marker of the match between a face representation in visual memory and a currently perceived face. To assess the integration of facial features during face matching, N250r components to partial repetitions of internal or external features were summed and compared the N250r to full face repetitions. For neurotypical participants, N250r components to full repetitions exceeded the summed N250r to partial repetitions for upright but not for inverted faces, indicative of integrated memory representations of upright faces. For DPs, N250r components were generally attenuated and delayed, and the N250r to full face repetitions did not exceed the summed N250r to partial repetitions. These findings provide neural evidence for the reduced activation of visual face memory and impaired integration of facial features in developmental prosopagnosia.

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### **Encoding Effects of Perceptual and Semantic Mnemonic Representations on Top-Down Biases across Development.**

ANDRIA SHIMI, GAIA SCERIF *University of Oxford.*

Visual working memory (VWM) is limited in capacity, and differentially so over the lifespan. Recent findings have shown that differences in the ability to use top-down attention to enhance maintenance are important for understanding developmental improvements in VWM (Shimi, Nobre, Astle, & Scerif, 2014). In this study, we explored whether perceptual and semantic characteristics of the memoranda influence participants' ability to selectively attend to and maintain items in VWM. Young adults, eleven-year-olds, and seven-year-olds were presented with a memory array of four items and were later asked to report whether a probe item had been part of the initial memory array. Memory array items belonged to the same or different semantic category. In addition, the memory array could either be uncued or followed by a spatial cue that directed participants' attention to a location in the array. Results showed that while participants in the three age groups differed in terms of their basic recall ability in the absence of an attentional cue, all participants' performance

was significantly improved by orienting their attention to the memory array voluntarily. Furthermore, children and adults were differentially able to exploit the semantic relatedness of the items to orient attention. These findings advance our knowledge on how characteristics of the memoranda influence deployment of attention across development.

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### **The Mismeasurement of Mind: Why Neuropsychological Test Results Overestimate Cognitive Decline.**

MICHAEL RAMSCAR, CHING CHU SUN, PETER HENDRIX and HARALD BAAYEN *Eberhard Karls Universität Tübingen.*

Performance on neuropsychological tests declines with age. This is taken as evidence that cognitive capacity declines across the lifespan, providing a functional characterization of structural change in the ageing brain. However, neuropsychological tests do not control for accumulated learning, and thus ignore the impact that increased knowledge and expertise can have on task performance. Here, we examine the effect of formally controlling for these factors on what is considered one of the most reliable measures of lifespan cognitive decline, Paired Associate Learning (PAL). We find that age-related changes in PAL performance are entirely consistent with the predictions of the error-driven "associative learning" models that represent the gold standard in other areas of behavioral and neuroscientific research. A modeling simulation shows how the changes seen in PAL performance across the lifespan. A simulation using a standard learning model shows that lifespan changes in PAL performance are consistent with increasing knowledge, and predicts that holding age constant while varying linguistic experience will produce the effects usually interpreted as age-related decline. Consistent with this, we show that in German PAL tests, older Chinese-German bilinguals outperform age-matched native German speakers, and this advantage increases with age. These results illustrate how neuropsychological tests inflate estimates of functional decline and distort our understanding of neurological change across the lifespan.

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### **Opposite Conclusions Drawn from Cross-sectional and Longitudinal Analyses of Adolescents' Cognitive-control Related Neural Activity.**

EVA H. TELZER & ETHAN M. MCCORMICK, *University of Illinois Urbana Champaign.* Although immature cognitive control capacities, subserved by a relatively late developing prefrontal cortex (PFC), have been proposed to underlie increased risk taking in adolescence, no clear picture exists of what patterns of activation represent "mature" brain states—more or less activation? One challenge to drawing conclusions from extant work is that it largely relies on single-time point comparisons. Thus, it is essential to utilize longitudinal fMRI to track changes in PFC function within adolescents and links to risk-taking behavior over time. At two time points, one year apart, 20 adolescents ( $M_{age}$  T1=14.4yrs, T2=15.2yrs) underwent an fMRI scan during which they completed a cognitive control task (Go-Nogo) and self-report measures of risk-taking. We regressed changes in risk-taking behavior onto neural activation during cognitive control at T1. Results indicate a negative correlation in the bilateral VLPFC; increases in VLPFC activation at T1 were associated with decreases in risk taking. Next, we examined how within-subject change in brain activation was

related to changes in risk-taking behavior. Results indicate a positive correlation in the bilateral VLPFC, but in the opposite direction, such that adolescents who showed longitudinal declines in VLPFC activation showed longitudinal declines in risk taking. The reversal in the association between VLPFC activation and changes in risk taking observed in the current study may reflect changing brain-behavior relationships across this transitional period and suggests that using neuroimaging at a single time point to predict behavioral changes can introduce interpretation errors when failing to account for changes in neural trajectories.

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FALLA ROOM,  
FRIDAY 6TH MAY, 17:20-19:00  
**TS15 Language Processing II**

**Complex Span Evidence for Shared Resources between Sentence Processing and Working Memory.**

CASSANDRA CHAPMAN, ELISABET SERVICE, *McMaster University*.

Previous work investigating the question of shared or separate resources for sentence processing and general working memory using complex span has consistently presented memory words at the end of processing, i.e., at the end of the sentence. In three experiments, we used a novel variant of complex span in which we presented memory words within sentences at particular syntactic locations. In Experiment 1, we found that word recall performance was poorer when the memory words appeared within the processing sentences compared to when the words appeared after the sentence, suggesting that sentence processing and general working memory share cognitive resources. In Experiment 2, we used digits instead of words as recall items and found that digit recall performance did not differ based on digit presentation location, suggesting that digit encoding is categorically different from word encoding. In Experiment 3, we manipulated the syntactic complexity of the processing sentences by using subject and object relative clauses. We found that recall was poorer for words presented within more complex sentences, i.e., object relative clauses. Moreover, we found that participants were more likely to recall words correctly when they appeared after the whole relative clause had been processed, compared to locations in which the relative clause structure was interrupted, suggesting that processing difficulty is ameliorated once a larger syntactic unit has been built. Overall, our results support a shared resource view for sentence processing and general working memory mechanisms: both syntactic complexity and word location influenced recall performance.

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**Beyond Decomposition: Processing Zero-Derivations in English Visual Word Recognition.**

LINDA WHEELDON, *University of Birmingham*, CHRISTOS PLIATSIKAS, *University of Reading*, PETER HANSON, DEBRA MALPASS, *University of Birmingham*, ADITI LAHIRI, *University of Oxford*.

Four experiments investigate the effects of covert morphological

complexity during visual word recognition. Zero-derivations occur in English in which the change of grammatical class occurs without any change in surface form (e.g., a bridge-to bridge; to bump-a bump). Bridge is object-derived and is a basic noun (N), whereas bump is action-derived and is a basic verb (V). As the suffix {-ing} is only attached to verbs, deriving bridging from its base, requires two steps, bridge (N)>bridge(V)>bridging(V), while bumping can be derived in one step from bump(V). Experiments 1 to 3 used masked-priming at different prime durations, to test matched sets of one and two-step verbs for morphological (bumping-BUMP) and semantic priming (jolting-BUMP). Experiment 4, employed a delayed-priming paradigm in which the full verb forms (bumping and bridging) were primed by noun and verb phrases (a bump/to bump, a bridge/to bridge). In both paradigms different priming patterns were observed for one-step and two-step verbs. Our results demonstrate that morphological processing cannot be reduced to surface form-based segmentation. Email: Linda Wheeldon. [l.r.wheeldon@bham.ac.uk](mailto:l.r.wheeldon@bham.ac.uk)

**Linking Recognition and Production: Cross-Modal Transfer Effects between Picture Naming and Lexical Decision in L1 and L2.**

EVA VAN ASSCHE, WOUTER DUYCK, *Ghent University*, TAMAR H GOLLAN, *University of California San Diego*.

The present study examined the extent to which production and recognition rely on shared representations in lexical access by examining cross-modality transfer effects and frequency effects in a training paradigm. We trained Dutch-English bilinguals in reading high- and low-frequency words in a lexical decision task and subsequently tested them in producing picture names and vice versa, in their second (L2, Experiment 1) and native language (L1, Experiment 2). Both tasks showed strong, within-modality repetition effects with faster responses and smaller frequency effects for repeated items. Training with repeated lexical decision, sped responses, and reduced the size of the frequency effects in subsequent picture naming, in both L1 and L2. In contrast, training with repeated picture naming sped responses in lexical decision, but did not significantly decrease frequency effects in L1 and in L2. These results imply an amodal representation (lemma) that is shared between production and recognition and is not sensitive to word frequency, and that a frequency sensitive phonological representation (lexeme) is activated automatically during single visual word recognition.

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**Speech Segmentation by Statistical Learning in Young, Middle-Aged, and Older Adults.**

SHEKEILA PALMER, JAMES HUTSON, SVEN MATTYS, *University of York*.

The purpose of our research is to investigate the age-related stability vs. decline of key word-learning mechanisms and to establish the extent to which age-related trade-offs take place with cognitive resources. In this study, we considered the interplay between statistical learning (SL) and working memory in young (20-30y), middle-aged (40-50y), and older adults (60-80y). Participants were asked to identify novel words in an artificial speech stream where the transitional probability between syllables provided the only segmentation cue. The stream was played at a normal or slow rate, and with or without an additional cognitive load (a concurrent 2-back



visual task). Overall, SL performance decreased with age, but to a surprisingly small extent: All groups were well above chance in the no-load condition. All groups showed poorer performance in the slow rate condition and, independently, under cognitive load. The older group was particularly disadvantaged when the stream was slow and accompanied with the 2-back task. Taken together, the data indicate that: (1) SL is remarkably robust across the lifespan, (2) Cognitive load impairs SL, (3) Slowing down the speech stream impairs SL, probably because decay makes it harder to maintain syllables in working memory long enough for binding, (4) Older adults are particularly affected by the slow rate when their working memory resources are compromised by the secondary task. The results suggest that SL draws upon a combination of core implicit mechanisms that are relatively stable across the lifespan, and cognitive resources that show an age-related decline.

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### **Influence of Working Memory Load on Language-Mediated Eye Movements.**

RAMESH MISHRA, *University of Hyderabad.*

Background: It has been shown that bilinguals activate words that are phonologically related to translation of spoken words. In two experiments, we examined the effect of a verbal working memory load on such activations in Indian bilinguals.

Methods and Material: Participants maintained a verbal working memory load concurrently while they listened to spoken words and looked at a display of words. The display consisted of a word phonologically related to the translation of the spoken word and three distractor words. After the visual world display, participants were checked on the accuracy of the working memory load recall. On some trials, participants were also asked a question regarding the identity of one of the objects in the display. In the first experiment, two or four letter verbal load was used. In the second experiment, two, six or eight letters were used as loads. Twenty-five Hindi-English bilinguals participated in each experiment.

Results and Discussion: We consistently found that the verbal working memory did not affect the looks towards the targets. However, the load modulated the accuracy on the visual world task. We conclude that a concurrent verbal working memory load affects only the strategic part of the visual world task but not language-mediated eye movements which are automatic.

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ANDALUCIA I & II ROOM,  
FRIDAY 6TH MAY, 17:20-19:00  
**TS16 Complex Cognition**

### **Embodied Cognition and Constructed Bodies.**

HASAN GÜRKAN TEKMAN, *Uludağ University.*

The popularity of the viewpoint that cognition involves sensory and motor representations rather than amodal, abstract representations is coexistent with viewpoints proposing that bodies, as much as anything else, are constructed. The relationship between these two viewpoints can be conceptualized in different ways. First, they may be considered incompatible. That is, we must have “real” bodies in order to have embodied cognition. Second, they may be considered irrelevant. Theorizing about embodied cognition may

be independent of what we assume about the real or constructed nature of bodies. Third, they may be compatible in the sense that embodied mental states may mean the same thing as constructed bodies. This third proposal is consistent with an extended cognition approach particularly, because it erases the difference between using our senses and bodies for representation and using representations in the environment that technically do not belong to our bodies. From mechanical devices to the electronic aids that surround us at present, many tools have come to serve us in a way indistinguishable from parts of our bodies. The transparency with which we use such tools in order to interact with the “environment” and pursue the goals that are set up by our survival problems demonstrate the uncertain boundary between what is and what is not our bodies that is open to flexible interpretations.

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### **When Script Is Not Essential: Effects of Directional Scanning of Speechless Comics on Lateral Spatial Biases in Language Comprehension.**

ANTONIO ROMÁN, ANDREA FLUMINI, JULIO SANTIAGO, *Universidad de Granada.* Reading and writing direction is linked to lateral (left-right) biases in mental model construction in language understanding, as well as number and time representations. However, time and number mental lines are in place before children begin to read. One potential cause are the experiences of looking at picture books together with a caregiver. In the present study, we tested whether the directional scanning of a speechless comic in either standard (left-to-right) or mirror reversed (right-to-left) form is enough to produce lateral biases in mental model construction in adult Spanish participants. In Experiment 1, the unconstrained exploration of the comic did not affect the lateral bias, perhaps because the task allowed exploring the page in many different ways. Experiment 2 presented the vignettes on screen in horizontal strips, appearing one by one, thereby forcing a fixed scanning pattern. Now, the mirror comic was able to reverse the lateral bias. Comics have inherent directionality in two ways: first, there is the direction of scanning between vignettes; second, there is the directionality of the actions within a vignette. Experiments 1 and 2 manipulated both sources of inherent directionality simultaneously. In Experiment 3, we manipulated only internal directionality by presenting vignettes one after another. Results showed that action directionality is not enough to affect lateral biases. To conclude, consistent scanning patterns of picture sequences (without script) are a sufficient cause of lateral biases in mental model construction in language comprehension, what supports its implication in the generation of lateral biases in pre-readers.

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### **Online Processing for Reading Relevant and Irrelevant Text Information: Evidence from Eye-tracking Study.**

INMACULADA ESCUDERO, *UNED*, LORENA M. ARNAL, JOSE D. MORENO, JOSE A. LEÓN, RICARDO OLMOS, *Universidad Autónoma de Madrid*, MARCOS RUÍZ, *UNED*, JOSE M. IGOA & MANUEL FROUFE, *Universidad Autónoma de Madrid.*

During the course of reading, the incoming text information is constantly interpreted by the prior knowledge activated by the perspective instructions and the standards of coherence (Sanford & Garrod, 1998). The aim of this study was to analyze whether

an instruction could affect to online processing (fixations, and regressions) manipulating the distance of the paragraphs. In this study 22 participants were instructed to read six expository texts so that they could find the answer to a question that appears into the end of the first paragraph. All texts contained three paragraphs where the response to the question was into the second or third paragraph (they were counterbalanced). The eye movement results revealed that the number of fixations by paragraph was greater for relevant than irrelevant target information ( $F(1,257) = 27.59$ ;  $p < .001$ ), as well as the number of regressions ( $F(1,258) = 13.88$ ;  $p < .001$ ), independently to the distance (second or third paragraph) from the question. However, non-significant interaction was founded. These results indicate that the instruction evoke intentions in the readers's mind being selectively directed to relevant text information independent to the distance (2° or 3° paragraph). This view is consistent with the *standards of relevance* (McCrudden et al., 2010) and *framework of perspective-driven test comprehension* (Kaakinen & Hyönä, 2008).

### A New and Implicit Tool to Evaluate the Severity of Depression: The Time Machine.

NICOLAS SPATOLA, *Clermont Université, Université Blaise Pascal and CNRS, UMR 6024*, JULIO SANTIAGO, *University of Granada*, MARC OUELLET, *University of Granada, Clermont Université, Université Blaise Pascal and CNRS, UMR 6024*.

Previous studies showed negative and positive valuations of the past and future concepts, respectively, in Western cultures. However, the tasks used in these studies allowed the participants to go into a reflexive process and were thus subject to strategic bias. Here, with more automatic tasks, we showed that this conceptual mapping of time onto the negative and positive poles is a psychological reality. What is more, we also observed that the participants' mood was responsible for a temporal bias. This bias was consistent with the Past-Negative/Future-Positive conceptual mapping, it is to say that the more depressive a participant was, the better she/he was to process past compared to future items. Based on this finding, we have elaborated a tool to evaluate the severity of the depression by calculating patient's temporal bias. The task is a go/no go task in which the participant has to press a button when the verb presented on the screen is conjugated to past or to the future, but not to the present. This tool has the advantage of evaluating implicitly the severity of the depression. Based on a two weeks experiment, this tool also seems able to follow the evolution of the depression through time. Implications of the present results for the fields of conceptual representations and clinical psychology will be discussed.

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### Whatever Happened to the Biology in "The Relationship in (Biology and) Experience between Various Types of Affect?"

ASGHAR IRAN-NEJAD, CATANYA G. STAGER, *University of Alabama*.

Four decades ago, researchers applied biofunctional schema theory to learn how study participants take multiple mutually exclusive perspectives on same surprise-ending stories. Inspired by the findings, Diener and Iran-Nejad (1986) applied the biofunctional mutual inclusion/exclusion (BMI/E) theory to emotions addressing how people entertained in mutual inclusion various types of co-

occurring emotions at lower levels of intensity ready to peak spontaneously in mutual exclusion into positive or negative valence. Results were published in JPSP with an emphasis on the role of BIOLOGY explicitly discussed, illustrated, and highlighted. The findings incubated for a decade and half through affective revolution of the 1990s before robust replication, stripped off of biology, in a flurry of experiments on mixed emotions after turn of the millennium, a meta-analysis of which by Berrios et al. (2015) did not even include the findings of the study that launched the original a priori evidence. This presentation discusses these and related findings. Email: [Asghar.Iran-Nejad@ua.edu](mailto:Asghar.Iran-Nejad@ua.edu)

## MACHUCA ROOM, FRIDAY 6TH MAY, 17:20-18:40 TS17 Numerical Cognition

### The Effect of Training on Tactile Enumeration.

ZAHIRA ZIVA COHEN, AVISHAI HENIK, *Ben-Gurion University of the Negev*.

Subitizing is a fast and accurate process of enumerating small quantities. There are differences in the behavioral results for different modality displays. The literature on enumeration in the tactile modality is sparse and the findings are diverse. Study 1 explored tactile enumeration of small quantities. Vibro-tactile stimulation was presented to between 1 to 5 fingertips on one hand. The results showed a moderate increase in response time (RT) up to 4 stimuli, and a decrease with 5 stimuli. Hence, with one hand, the subitizing range was 4 rather than 3 (as suggested earlier). However, due to the large amount of errors made by the participants and larger RT slopes, in comparison to a visual display, there is still a question whether this pattern represents tactile subitizing. In order to increase accuracy, Study 2 utilized multi-day practice of a tactile enumeration task. We examined the effect of training with 2 groups: daily training for 6 days and controls. We tested performance 1 week, 4 weeks and 6 months after training. The results showed a decrease in RT and an increase in accuracy rates after training. Importantly, improved performance did not change the RT pattern found in Study 1. The control tasks we conducted, along with the practice, suggest that participants improved in tactile sensitivity and general enumeration.

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### Diffusion Modeling of the Approximate Number System.

ROGER RATCLIFF, GAIL MCKOON, *The Ohio State University*.

Models that have been developed to represent the numerosity of non-symbolic displays (e.g., arrays of blue and yellow disks) have assumed a representation in which integer values are represented as distributions on a number line around their mean values (termed the approximate number system). In one of the models, the mean of the distribution and its standard deviation increase linearly with numerosity. In the other model, the standard deviation is constant but the mean increases logarithmically. Both models account for the finding that discriminability between numerosities is reduced as numerosity increases. The models are not distinguishable when





applied to accuracy data but if the distributions they produce in response to stimuli are used to define drift rate in the diffusion model (a sequential sampling decision model), then the models are identifiable. We report experiments in which arrays of blue and yellow disks are displayed and participants report which color has the higher number. The model with standard deviation in drift rate increasing with numerosity predicts decreasing response times and accuracy as a function of numerosity for constant differences between the two disk colors, whereas the logarithmic model predicts increasing response times and decreasing accuracy. We found that the diffusion model with the standard deviation increasing with numerosity best fit the data.

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### **Deciding There Are More Strawberries Than Apples Is More Difficult Than Deciding There Are More Apples Than Strawberries.**

BERT REYNVOET, *University of Leuven*.

Numerosity processing is typically addressed with a numerosity discrimination task in which participants have to decide which dot array is more numerous. Recent studies have shown that performance depends on the congruency between number and visual features of the stimuli (cumulative area, dot size...). Discriminations are more accurate and faster when the more numerous array has larger visual features (congruent trials) compared to trials where the less numerous array has larger visual features (incongruent trials). However, these studies typically use well controlled artificial stimuli (dot arrays) and it remains to be examined whether congruency effects also influence discrimination of real-life objects. In this study, we contrasted the performance of 30 adults in two identical numerosity comparison tasks that only differ in the objects presented: classics dot arrays versus arrays of real life objects. In the latter condition, congruency was manipulated by presenting large and small objects from the same category (fruits: apples, strawberries...). The same effects were observed in both conditions: performance was affected by size, ratio and most importantly, congruency: deciding there are more apples than strawberries is easier than the opposite. These results indicate that also in everyday situations, numerosity processing is partly driven by the visual characteristics of the object.

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### **Automatization through Procedure Acceleration vs. Memory Retrieval: The Case of Mental Addition.**

CATHERINE THEVENOT, *University of Lausanne*, KIM UITTENHOVE, CAROLINE CASTEL, *University of Geneva*.

Logan and Klapp (1991) provided strong support to the associationist theory by showing that intensive practice in alphabet-arithmetic eventually leads to calculation automaticity. The authors concluded that automatization occurs through progressive memory retrieval of the newly acquired arithmetic facts. Our study was conducted in order to reexamine these conclusions in light of new insights of the literature suggesting that very small additions such as  $3 + 2$  could still be solved by counting procedures in expert adults. Following Logan and Klapp, we trained 19 adults to verify equations such as  $D + 2 = F$  and we analyzed the evolution of solution times across 25 practice sessions. The letters of the alphabet could be associated with addend from 2 to 5 and two different patterns of behaviors emerged from our data. On

the one hand, the slope of the function relating solution times to addends from 2 to 4 remained clearly linear until the end of the training, suggesting that counting procedures still accounted for individuals' behaviors within this problem range. On the other hand, a decrease in solution times observed for problems involving 5 suggests that counting was not efficient enough when five steps were required and that retrieval took over such demanding procedures. The results of this research challenge the long-standing and undisputed assumption that retrieval of arithmetic facts constitutes the optimum strategy for simple addition problems and demonstrate that fast procedures, probably automatized through extensive practice, can be faster than retrieval.

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### **ANDALUCIA I & II ROOM, SATURDAY 7TH MAY, 8:00-10:00 TS18 Language Processing III**

#### **Word-Meaning Induction from Minimal Exposure to Natural Text: A Multi-Modal Computational Model.**

MARCO MARELLI, ANGELIKI LAZARIDOU, MARCO BARONI, *University of Trento*.

By when they reach early adulthood, English speakers are familiar with the meaning of thousands of words, prompting the question of how they accomplish this feat. In the last decades, computational simulations known as distributional semantic models demonstrated that it is possible to induce word meaning representations solely from word co-occurrence statistics extracted from large amounts of text. However, these models work in batch mode, while human word learning is highly incremental, and often proceeds from minimal exposure to new words.

In this study, we first run a set of experiments investigating whether minimal distributional evidence from very short text passages suffices to trigger successful word learning in subjects. We devise a new experimental task in which participants were presented with short texts concerning novel words, obtained by substituting selected target words in a sample of natural sentences. Participants were asked to produce both linguistic and visual intuitions about these novel concepts. After confirming that subjects are indeed very efficient distributional learners, we test a distributional semantic model on the same multimodal task. The architecture we propose derives meaning representations by learning to predict the linguistic and visual contexts in which words occur (as approximated through large collections of texts and images). When tested on the novel-word task, we find that such a model behaves in a remarkable human-like way.

In conclusions, distributional semantic models provide a convincing computational account of incremental word learning. Moreover, the distributional framework can be profitably used to develop psychologically plausible representations of multi-modal meanings.

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### Listeners Use Experience across a Range of Timescales to Guide the Interpretation of Ambiguous Words.

JENNIFER M. RODD, ZHENGUANG CAI, *University College London*.

Most words have multiple meanings (e.g., bark of the tree/dog). Recent experiments have shown that recently encountered meanings are more readily available, presumably making them easier to comprehend in natural conversations (Rodd et al., 2013). Here, we explore this word-meaning priming effect using more naturalistic settings and a wider range of timescales. The disambiguated ambiguous word primes were presented within a radio programme (Experiment 1;  $N=1800$ ) or a conventional lab-based experiment (Experiment 2). At test, we measured the proportion of word association trials on which the primed meaning was generated. Results show that just one instance of an ambiguous word can produce word-meaning priming after a delay of up to 40 minutes, but priming decays rapidly during this interval. Experiments 3 and 4 explored longer-term priming by measuring the impact of extended, naturalistic exposure to ambiguous words. Recreational rowers ( $N=213$ ) retrieved rowing-related meanings for words (e.g., “feather”) more often if they had rowed that day, despite a median delay of 8 hours between their rowing and testing. The rate of rowing-related interpretations also increased with additional years’ rowing experience. Taken together these experiments show that overall meaning preferences reflect experience across a range of timescales from minutes to years. In addition, priming was not reduced by a change in speaker identity (Experiment 1), suggesting that the phenomenon occurs at a relatively abstract lexical-semantic level. Priming was reduced for older adults (Experiments 1, 3, 4) suggesting that the lexical-semantic representations of younger listeners may be more malleable to current linguistic experience.

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### Strongly versus Weakly Perceptual: Why the Abstract/Concrete Distinction Has Outstayed its Welcome.

LOUISE CONNELL, DERMOT LYNOTT, *Lancaster University*.

Concrete words are read faster and remembered better than abstract words, which is traditionally assumed to be because concrete concepts possess perceptual information that abstract concepts lack. However, recent work (Connell & Lynott, 2012) has shown that concreteness ratings are a poor reflection of the perceptual basis of concepts, and that perceptual strength (i.e., how strongly a concept’s referent is experienced through its dominant perceptual modality) is a better predictor of lexical decision performance than concreteness, all of which casts doubt on the usefulness of the “concreteness” as a theoretical construct. In the present studies, we compared the abilities of concreteness and perceptual strength to predict performance in two key tasks where the abstract/concrete distinction has traditionally been important: word recognition (RT and accuracy for lexical decision: Keuleers et al., 2012) and recognition memory (hits-minus-false-alarms for self-paced and passive learning: Cortese et al., 2010, 2015). In large-scale regressions, we fitted separate models for concreteness and perceptual strength (including the same lexical and sublexical predictors), and then used Bayesian model comparisons to determine which best explained the data. Results showed that perceptual strength outperformed concreteness in both word recognition ( $N$

= 770 words) and recognition memory ( $N = 556$  words). These findings suggest that the ontological distinction between abstract and concrete concepts is of less relevance than whether concepts are strongly or weakly grounded in perceptual experience.

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### Pupil Size Reflects Semantic Brightness of Words.

SEBASTIAAN MATHÔT, JONATHAN GRAINGER, KRISTOF STRIJKERS, *CNRS / Aix-Marseille University*.

An embodied view of language holds that, to understand a word, you must prepare associated actions (e.g., prepare finger movement to understand “typing”), and simulate associated sensory input (e.g., simulate perception of brightness to understand “light”). To test this, we investigated whether words can elicit physiological responses that are associated with their meaning; specifically, we measured pupillary responses to words that convey a sense of brightness (e.g. “day”) or darkness (e.g. “night”). Because brightness triggers pupillary constriction, we predicted that the pupil would be smaller after reading a brightness-conveying, compared to a darkness-conveying, word. Participants ( $N = 30$ ) read single words and pressed a key when the word was an animal name. The remaining (non-animal) words were associated with brightness or darkness, or were neutral (not associated with a specific brightness). Words were shown for 3 s, and were matched on lexical and visual properties. We collected normative ratings to control for the valence and emotional intensity of the words. Crucially, from about 1 s after word onset, the pupil was largest for darkness-conveying words, intermediate for neutral words, and smallest for brightness-conveying words. This finding is consistent with an embodied-language view, and suggests that, at least in some cases, word comprehension involves automatic, physiological responses; for example, understanding that the word “sun” refers to a bright object induces, or may even rely on, pupillary constriction.

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ALBENIZ ROOM,  
SATURDAY 7TH MAY, 8:20-10:00  
TS19 Reasoning I

### Mindset Matters: Human-Centric Overshadows Mind-wandering For Ideation.

JULIET CHOU, *Columbia Teachers College*, BARBARA TVERSKY, *Columbia Teachers College and Stanford University*.

Finding new and original ideas and solutions can be challenging in everyday situations as well as in innovation in design, science, business, and technology. Some have claimed that mind-wandering increases ideation. However, premier design firms and schools recommend human-centric approaches. In two experiments we asked participants to generate new ways to use 7 common objects using either a mind-wandering or human-centric mindset. The first study ( $n=105$ ) had a no-mindset control and names of objects. In the second study ( $n=148$ ) half the participants saw pictures of the objects and the other half saw names. The dependent measures were fluency, that is, number of ideas, and originality of ideas, that is, ideas produced by only 5% of participants. In both studies, the human-centric mindset yielded both more ideas and more original



ideas. Words yielded more ideas than pictures only for those using a human-centric mindset. Participants given no mindset frequently reported spontaneously using mind-wandering; their performance did not differ from mind-wandering and was surpassed by those using a human-centric mindset. Original ideas were more frequently produced later in ideation. The effectiveness of the human-centric mindset seems to derive from people's ability to imagine many different tasks and situations encountered by people in different roles and occupations. Participants used that knowledge as a search strategy to find new and innovative ideas.

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### Contextual Determination of Adolescent Lie- and Truth-telling.

CATHERINE ANN CAMERON, JESSE LO, *University of British Columbia*, ALESSANDRA RIBEIRO, *Universidade Federal De Santa Catarina*.

Recent investigations of developmental social cognition consider individualist/collectivist cultures (Chinese and Canadian) and context (manipulated group-size) considerations in verbal deception. While *classifications* of lies as lies and truths as the truth are common across many cultures, lie and truth *judgments* relate to youthful participants' cultural backgrounds (Fu et al., 2007) and come to align with those of adults in their cultures as they mature. *Justifications* of moral judgments are also culturally- and contextually-determined with increased age (Lau et al., 2011). Chinese participants valued collectivistic contexts over individual ones, whereas Canadians prioritize individualistic contexts. This study examines *choices* (behavioral intentions), *classifications*, *judgments*, and *justifications* of 105 Canadian and Chinese-Canadian adolescents responding to scenarios in which protagonists tell shielding lies or whistle-blowing truths about athletic best friends or compatriots discovered using performance-enhancing substances. When asked what they would say (behavioral intentions), 63.6% indicated they would lie to protect their friend whereas 28.6% said they would lie to protect their home-country ( $\chi^2(df3,104)=13.9$ ;  $p>.003$ ;  $r_\phi=.33$ ). Despite personal behavioral *choices*, *judgments* of scenario protagonists' lies to protect friends were not different from lies to protect countries but *judgments* of truths that expose friends were more negative than truths to expose countrypersons ( $F(1,103)=4.10$ ;  $p>.05$ ;  $r_\phi=.03$ ), and *justifications* for lies exposed reasoning for situational differentiations between lies for friend being most frequent (40.5%) by appeal to prioritizing friendships; whereas 50% of patriotic truth-telling entailed absolutist justifications, confirming contextual reasoning in these youth living in a multi-cultural community. Social-cognitive reasoning was affected by situational variations that reflected these adolescents' cultural values. Email: Catherine Ann Cameron, [acameron@psych.ubc.ca](mailto:acameron@psych.ubc.ca)

### Individual Differences in Knowledge Organization Preferences and Reasoning.

MITCHELL RABINOWITZ, BROOKLYN DO, ELENA THOMOPOULOS, *Fordham University*.

Two notable examples of different types of knowledge organization are thematic and taxonomic organization. Previous research has investigated group level difference in organizational preference e.g., younger (thematic) compared to older (taxonomic); learning disabled (thematic) compared to non-disabled (taxonomic); non-

literate (thematic) compared to literate (taxonomic). The more cognitively advanced group is associated with the preference for taxonomic organization. In addition, research on cultural differences (east compared to west) has suggested that collectivist cultures (east) prefer thematic relations whereas individualistic cultures (west) prefer taxonomic. Addition evidence also suggests that preference might differ by content domain – thematic for history; taxonomic for animal kingdom. The current research investigated whether individual difference in organizational preference by domain might be related to performance on analogical and insight tasks. Two studies were conducted, using a national sample recruited using Mechanical Turk, where participants were presented with a triad judgment task with content related to history and the animal kingdom. Three primary groups of participants were observed; 1) preferred thematic relations for history and taxonomic relations for animal kingdom; 2) preferred taxonomic relations for both, and 3) preferred thematic relations for both. In experiment 1, participants were then given analogy problems to solve; in experiment 2, insight problems. Results from both experiments showed that participants who were flexible in their organization preference (group 1) performed significantly better than those who preferred thematic relations (group 3). Those who had a consistent taxonomic preference (group 2) exhibit levels of performance in between the other two groups.

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### Cognitive Sophistication as a Predictor of Victim Blaming.

JAMIE PROWSE TURNER, ANOMI BEARDEN, JAZMYN BORGEL, *Red Deer College*.

To explore whether individual differences in cognitive sophistication (a measure of a person's cognitive ability and thinking dispositions) predict ones tendency to victim blame when under just world threat, participants read and responded to a vignette of a just world manipulation that included either: a threat condition (severe prolonged suffering of an innocent victim), or a no threat condition (moderate temporary suffering). Participants were also asked to complete scales measuring victim blaming and cognitive sophistication. A multiple regression analysis revealed that participants were likely to defensively blame the victim when under just world threat, regardless of their individual differences in cognitive sophistication. However, in the absence of a just world threat, aspects of cognitive sophistication (open-mindedness and emotional intelligence) were found to be predictors of victim blaming. Specifically, as open-mindedness and emotional intelligence increase, victim blaming decreases. Observer's degree of cognitive sophistication can impact reactions to those who suffer when observers are not in an emotional motivational state, and may be thinking more rationally. However, when observers are in a defensive state, due to their belief in a just world being under threat, observers' level of cognitive sophistication does not buffer the biased tendency to blame victims for their suffering. These findings are tied to thinking biases and judgements.

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## Developmental and Instructional Changes in Intuitive Biological Thought.

JOHN D. COLEY, *Northeastern University*, KIMBERLY D. TANNER, *San Francisco State University*.

**Introduction.** Intuitive biological thought (common sense reasoning about living things) can be broadly characterize in terms of cognitive construals: anthropocentric thinking (reasoning by analogy to humans), essentialist thinking (belief in an underlying principle that causes surface features) and teleological thinking (causal reasoning based on a goal or outcome). Usually studies in childhood, we examined the developmental trajectory of such thinking into adolescence and early adulthood, and also asked how formal biology education might influence intuitive reasoning. **Method.** 74 8<sup>th</sup> graders (age 12-13), 69 undergraduate biology majors and 68 non-science majors from the northeastern USA were given a written survey consisting of a series of measures of anthropocentric, teleological, and an essentialist thinking. **Results.** Based on composite measures for each construal, biology majors showed less anthropocentric thinking than non-majors or 8<sup>th</sup> graders (who did not differ); biology majors showed less teleological thinking than non-majors, who showed less than 8<sup>th</sup> graders; and biology majors and non-majors did not differ in essentialist thinking, and both showed more than 8<sup>th</sup> graders. For specific measures, differences among student groups were consistently markedly smaller than effects of within-measure manipulations for each task. **Conclusions.** Anthropocentric, teleological and essentialist thinking persist through adolescence into young adulthood. Differences between 8<sup>th</sup> graders and university student groups, and between biology majors and non-majors, were surprisingly small. These results suggest that there may be interactions between persistent intuitive reasoning and formal biology education that have not been previously investigated and that may have implications for biology teaching in school and university settings.

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## FALLA ROOM, SATURDAY 7TH MAY, 11:00-12:40 TS20 Language Production

### The Influence of Orthographic Experience on the Development of Proximate Unit in Spoken Word Production.

CHUCHU LI, *University of California, San Diego*.

Proximate unit is the first selectable phonological unit after lexical selection in the planning of spoken word production. Proximate units differ across languages in adults (e.g., phoneme in English, atonal syllable in Mandarin). This study investigated the development of proximate unit in children and the influence of orthographic experiences. Participants included native Mandarin speakers from four age groups with different experiences regarding alphabetic Pinyin and morphosyllabic Chinese character. Grade 1, 2, 4 children and Adults named pictures with the form preparation paradigm. The names may share the same onset (O+), initial atonal syllable (AS+), initial tonal syllable (TS+), or nothing systematically in common (i.e., the control condition). In the O+ condition, Grade 1 children showed significant facilitation regardless of the word length. Other groups failed to show any effect. For AS+, only Grade 4 children

and Adults showed significant facilitation. Grade 2 children only showed significant facilitation in the TS+ condition. Namely, Grade 1 children selected onset as the proximate unit, Grade 4 children and Adults selected atonal syllable, while Grade 2 children selected tonal syllable. Reading tests and questionnaires suggested that the only consistent and significant difference between Grade 1 children and other groups was Grade 1 children's longer relative exposure to Pinyin, which may encourage them to attend to and select subsyllabic units as proximate units. More exposure to morphosyllabic character may encourage skilled readers to choose syllable segment. Grade 2 children may be in the transition period. In summary, orthographic experiences influence children's development of proximate unit.

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### Unifying Structural Priming Effects on Syntactic Choices and Timing of Sentence Generation.

KATRIEN SEGHAERT, LINDA WHEELDON, *University of Birmingham*, PETER HAGOORT, *Max Planck Institute for Psycholinguistics*.

Two experiments investigate whether structural priming of production latencies is sensitive to the same factors known to influence structural priming of choices, using active/passive voice alternation in a picture description paradigm. The Two-stage Competition model (Segaert et al, 2014) is an integrated model of structural priming effects for both aspects of sentences generation, and predicts that structural priming effects on both choices and latencies will be modulated by cumulativity, verb repetition and structure preference. In Experiment 1 we tested for immediate and long-lasting cumulative effects of structural priming. In choices we found priming for passives to be influenced by immediate and long-lasting cumulativity. In latencies we found priming for actives sensitive to long-lasting cumulativity. In Experiment 2 we tested whether the structural priming effects are boosted by verb repetition. In choices we found priming of passives to be boosted by verb repetition. In latencies we found priming for actives overall, while for passives the priming effects revealed as the cumulative exposure increased but only when also aided by verb repetition. Since actives versus passives are high versus low frequent structures respectively, we could also assess the effect of structure preference on priming observed in both dependent measures. In both experiments there were priming effects in choices only for passives (i.e. inverse preference effect), while the effects in latencies were stronger for the actives (i.e. positive preference effect). These findings are consistent with the Two-stage Competition model: common mechanisms underpin structural priming observed in the choice and latency of sentence generation. Email: Katrien Segaert, [k.segaert@bham.ac.uk](mailto:k.segaert@bham.ac.uk)

### Typing Pictures: When Linguistic Processing Falls Into Finger Movements.

MICHELE SCALTRITTI, *Università di Padova and Aix-Marseille Université*, BARBARA ARFE', *Università di Padova*, MARC TORRANCE, *Nottingham Trent University*, FRANCESCA PERESSOTTI, *Università di Padova*.

The overarching aim of the present study is to outline the functional organization of the stages related to cognitive processing and response execution during typewritten word production. More specifically, the effects of psycholinguistic variables on measures of





response latency and response duration (i.e., mean interkeystroke intervals) during a typewritten 'picture naming' task are reported. The results indicate that onset latencies appear to be modulated by major lexical semantic variables traditionally linked to lexical retrieval, such as word frequency, age of acquisition, and naming agreement. Rather, orthographic variables, both at the lexical and sublexical level, appear to influence solely mean interkeystroke intervals, suggesting that orthographic representations may be fully processed and retrieved during actual response execution. Finally, some of the considered lexical semantic variables have the ability to influence measures concerned with response execution. We contend that these findings could be interpreted as a demonstration of a cascaded flow of activation between stages of lexical access and response implementation.

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### **An Elusive Causal Relationship between Emotional Arousal and Tip-of-the-Tongue States.**

LISE ABRAMS, DANIELLE K. DAVIS, *University of Florida*, LORI E. JAMES, *University of Colorado, Colorado Springs*.

Tip-of-the-tongue (TOT) states represent a temporary inability to retrieve a known word. Despite anecdotal claims that arousing states such as stress or anxiety increase susceptibility to TOTs, the empirical evidence linking emotional arousal and TOTs has been mixed. We conducted three experiments with college-aged participants, where emotional arousal was induced prior to answering a general knowledge question. On half of the trials, emotional arousal was elicited either by viewing negatively or positively-valenced pictures taken from the International Affective Picture System (IAPS) or by producing taboo words. The remaining trials presented a neutral picture or word. Following the picture/word, participants

read a general knowledge question whose answer was a specific target word, and they indicated whether they knew, did not know, or were having a TOT for the answer. The results demonstrated a causal link between high emotional arousal and TOTs, but the nature of this relationship was dependent on the source of emotional arousal: Arousing pictures increased TOTs, whereas arousing language decreased TOTs. These results are discussed in terms of mechanisms that may be responsible for a relationship between emotional processing and phonological retrieval.

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### **Preserved Cumulative Semantic Interference Despite Explicit Memory Impairment.**

GARY M. OPPENHEIM, *Bangor University/Rice University*, POLLY BARR, *Macquarie University*, MARIE-JOSEPHE TAINURIER, *Bangor University*.

Several current models describe a role for implicit learning in continually re-tuning the language production system, claiming specific behavioral effects (e.g. syntactic priming, phonotactic learning, cumulative semantic interference) as demonstrations of implicit learning over various mappings. But because speaking is typically quite memorable, it can be difficult to distinguish true implicit learning from concomitant explicit memory for the learning events. This single-case study considers possible explicit memory contributions to two picture-naming paradigms where implicit learning is often claimed to underlie cumulative semantic interference in response times. Patient WRP is a 52-year-old male who has unilateral lesions to his left hippocampus, amygdala,

and anterior to medial temporal lobe, resulting in *ceteris paribus* impaired recognition and recall of words, but fully intact linguistic processing and only mildly impaired semantics. After ruling out semantic refractory disorders as alternative sources of interference, we show that his naming latency patterns exhibit canonical and control-like cumulative semantic interference in both continuous and blocked-cyclic picture naming paradigms, leading to the conclusion that interference in both specifically reflects persistent implicit changes. Finally, we also consider an underappreciated role for explicit memory in typical laboratory picture naming experiments, which may explain some curious neuroimaging results for one of these paradigms.

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## **ANDALUCIA III ROOM, SATURDAY 7TH MAY, 11:00-12:40 TS21 Perception and Action**

### **Contribution of Different Inhibitory Mechanisms to Motor Imagery.**

MARTINA RIEGER, STEPHAN F. DAHM, *UMIT Hall in Tirol*, IRING KOCH, *RWTH Aachen University*.

Motor imagery requires that actual movements are prevented (i.e., inhibited) from execution. To investigate whether and how inhibition takes place in motor imagery we developed a novel action-mode switching paradigm. Participants imagined (indicating only start and end) and executed movements from start buttons to target buttons. Trials were presented in pure and mixed blocks. We analyzed trial sequence effects. Trial sequences depended on current action mode (imagination or execution), previous action mode (pure blocks/same mode, mixed blocks/same mode, or mixed blocks/other mode), and movement (target and hand repetition, hand repetition only, or hand alternation). Results provided evidence for three inhibitory processes. First, effector specific inhibition was indicated by hand repetition costs when the previous trial was an imagination trial. Second, global inhibition was indicated by the relative difficulty of different action mode sequences (e.g. switch benefits in execution-imagination-sequences compared to imagination-imagination-sequences may result from reduced global inhibition after an execution trial). And third, inhibition as part of motor imagery was indicated by target repetition benefits in imagination-imagination sequences. Thus, several inhibitory mechanisms contribute to motor imagery. Motor imagery is not simply a weaker form of execution. Rather, active inhibition (global and effector specific) takes place. An applied conclusion is that in sports competitions motor imagery shortly before actual performance may have detrimental effects.

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### **The Relationship between Choice and Speed in Action Decisions.**

PETROC SUMNER, ALINE BOMPAS, *Cardiff University*.

In the dominant models of simple action decisions, alternative possibilities compete through activity accumulating towards threshold. When the activity representing one option reaches threshold, the decision is made and that action is executed. At the

heart of the first-to-threshold concept is a relationship between choice and speed; the quicker activity rises, the more likely it is to win the decision process. We illustrate how the predicted relationship between choice and speed is qualitatively similar across different classes of computational decision model no matter what the details of its structure, accumulation or competition processes. Investigating this relationship is then a critical test for our current approach to action decision models, but it has rarely been discussed or questioned. We find that for simple saccadic choices between stimuli of different contrast, a rise-to-threshold model works remarkably well: when we just fit the latency distributions for individual stimuli, the model accounts not only for the proportions of choice between them, but also for the pattern of choice latencies without any further adjustment. However, we also report another simple case where the choice-latency relationship is broken, challenging the ability of such models to account for choice beyond specific circumstances. We attempt to integrate this problem with alternative concepts for how decisions are made: top down control, conflict detection and the possibility of other rate-controlling factors, rather than the building of activity for response alternatives.

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### Knowing Where to Go When You Get There: Dynamic Construction of Spatial Knowledge during Skilled Action Sequencing.

LAWRENCE P. BEHMER JR., MATTHEW J. C. CRUMP,  
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Experts can type quickly and accurately, yet have poor explicit knowledge of key locations. For example, error rates during free recall of letter locations are around 43%, compared to 6% during normal typing (Snyder et al., 2013). Hierarchical theories resolve this paradox by proposing an outer loop that provides word-level representations to an inner loop that translates letters into keystrokes. The inner loop might possess a high-fidelity internal spatial map, yet typing speed and accuracy decline when tactile feedback is removed, suggesting the fidelity of the spatial map changes momentarily in response to kinesthetic cues (Crump & Logan, 2010). The present work investigates whether online changes to the fidelity of the spatial map guiding accurate typing also depend on what is being typed. In three experiments, we had participants type English, English-like, and random strings while participants typed on a normal QWERTY keyboard, a keyboard with each letter covered with stickers, and a keyboard occluded underneath a box. Error rates were highest during the occlusion compared to the sticker condition, which were higher than normal typing. There was no difference in error rates for string type during normal typing; however, error rates were higher for random compared to English and English-like strings during the occlusion and sticker conditions. This suggests that sequential structure in word-strings contributes to the dynamic construction of spatial knowledge guiding keystrokes during typing.

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### Do Subliminal Primes Influence Voluntary Choice in Oculomotor Action?

SEEMA PRASAD, KAUSHIK L. SAKE, RAMESH MISHRA,  
*University of Hyderabad.*

**Background:** Several studies have shown that stimuli presented below the threshold of awareness can influence motor responses. In two experiments, we examined whether subliminally presented primes can also bias the voluntary choice of an oculomotor response. **Material and Methods:** In the first experiment, masked arrow primes were presented that either matched or mismatched the visible arrow cues on cued trials. Participants were instructed to make a saccade to the location pointed to by the arrow cue. On voluntary trials, following the masked primes, participants were expected to choose a target location and generate a saccade to that location. In the second experiment, arrow primes were replaced with four numbers (1,2,3 and 4) where each number corresponded to a quadrant on the screen. Primes were presented for 25 ms. Forward and backward masks were presented for 100 ms each.

**Results and Conclusion:** In both experiments, we observed that primes affected participants' response latencies on cued trials as well as choice of location on voluntary trials. We conclude that unconscious stimuli can affect the choice of responses even in the oculomotor domain. Pupillary analysis of the data showed that trials involving a mismatch between prime and choice of response elicited more mental effort. Thus, we also discuss a novel way of tracking the influence of subliminal primes on choice behaviour.

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### Dynamics of Spontaneous Alpha Activity in Perceptual Organization and Perceptual Learning.

ANDREY R. NIKOLAEV, *KU Leuven.*

Fluctuations of spontaneous cortical activity in the alpha frequency band are known to affect the perception of upcoming stimuli. Here we describe a new mechanism underlying effects of spontaneous alpha activity on perceptual learning. We measured alpha activity preceding ambiguous visual stimuli: dot lattices, in which dots were seen to group along one or another orientation as a function of their proximity. Initially, participants responded more often according to their intrinsic biases for vertical orientations than according to dot proximity. The bias decreased in the course of the experiment, consistent with the notion that perceptual learning is accompanied by a reduction of intrinsic perceptual biases. As participants learned the task, the role of bias decreased and the role of sensitivity to dot proximity increased. As long as the bias was prominent, we observed an intermittent regime of alpha activity in which a mode of low amplitude and high persistency alternated with a mode of high amplitude and low persistency. The first mode supported biased responses; the second unbiased responses. Thus, alpha activity appears to reflect alternating episodes of receptivity to the information to be learned and relapse to the pre-learning bias.

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MACHADO ROOM,  
SATURDAY 7TH MAY, 10:40-12:40  
**TS22 Memory II**

**The Reminiscence Bump without Memories: The Distribution of Imagined Word-Cued and Important Autobiographical Memories in a Hypothetical 70-Year-Old.**

JONATHAN KOPPEL, DORTHE BERNTSEN, *Aarhus University*. The *reminiscence bump* is the disproportionate number of autobiographical memories dating from youth and early adulthood. The bump is located earlier when memories are cued in response to cue words, compared to when participants are asked to report important memories. It has often been ascribed to a consolidation of the mature self in the bump period, which purportedly leads to events of this period being favored in subsequent memory. Here we argue, however, that the differential locations of the bump suggest that it is largely a function of schematic processes operative at retrieval, inasmuch as these differential locations are effectively produced by manipulating the retrieval strategy employed by participants. To test this premise, in Study 1, we collected word-cued and important autobiographical memories from an online US sample of 61-70-year-olds. Then, in Study 2, we asked Danish students to generate imagined word-cued and important autobiographical memories of a hypothetical, prototypical 70-year-old of their own culture and gender; this procedure strips away factors relating to the characteristics of autobiographical memories *per se*, most notably factors that aid in their encoding, leaving participants reliant on general schematic processes. We found a striking similarity between the temporal distributions of the imagined memories and the actual memories, including an earlier reminiscence bump for imagined word-cued memories and a later bump for imagined important memories. These results further suggest that the reminiscence bump is largely driven by constructive, schematic factors at retrieval, thereby challenging most existing theoretical accounts.  
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**Vision at a Glance: Schematic Knowledge Enhances Memory for Both 'Gist' and Visual Detail Information Following a Brief Glimpse.**

NURIT GRONAU, ANNA IZOUTCHEEV, INBAL RAVREBY, ELIA BARKAI, *The Open University of Israel*. How vivid is our memory following a very brief glance? Visual information tends to fade over time, such that only salient objects and events within a scene are retained in long-term memory. Schematic knowledge may aid in the encoding and retrieval of specific items, yet there is an unresolved dispute concerning the nature of this effect – are contextually consistent, or inconsistent stimuli mostly enhanced and remembered? Furthermore, relatively little is known about the contribution of associative information to recognition of the *precise visual appearance* of objects. Since schematic knowledge is typically thought to be abstracted from instances or episodic detail, information about perceptual details may be orthogonal and irrelevant to the schema. Here we investigated the effects of contextual consistency factors on memory for categorical (i.e., item type) as well as for visual detail (token) information of merely glimpsed objects. Participants viewed pairs of contextually

related and unrelated stimuli. They then performed a forced-choice memory recognition task that tested for both category and visual detail knowledge. Results showed that categorical memory (e.g., recognizing an old pair of scissors) was overall enhanced for stimuli appearing within contextually-consistent, relative to contextually-inconsistent pairs. Interestingly, this effect was largely explained by the specific visual appearance of the items (e.g., recognizing the *red* pair of scissors) within the consistent pairs. We propose that that during a brief glimpse, contextual associations play an important role in reducing stimulus competition and in facilitating rapid encoding of an item's 'gist' as well as its sensory details.  
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**Reconstruction of Autobiographical Memory of Violent Sexual-Affective Relationships through the Experience of Scientific Reading on Love.**

SANDRA RACIONERO, *Loyola University Andalucia*, LIDIA PUIGVERT, *University of Cambridge*, LEIRE UGALDE, *Universidad del País Vasco*, CARMEN GÓMEZ, *Loyola University Andalucia*. Prior research has shown the existence among female adolescents of attraction toward violent masculinities resulting from a learning process where attractiveness is associated to aggressiveness and disdain. Once violent sexual-affective relationships have been experienced memories of those become the ground for perceiving and processing next sexual-affective experiences. However, little has been inquired about which types of social experiences and language uses may induce recall of those autobiographical episodes to generate their emotional reconstruction. Starting from the malleability of autobiographical memory, and the important role of language in memory processes, a qualitative study examined in a Spanish sample of female adolescents (N = 30, age range 17-20), whether their experience of scientific reading on love, a text which included a critical analysis of violent and non-violent relationships using 'language of desire', modified in any ways the adolescents' autobiographical memories of violent sexual-affective relationships. Their memory reports were collected before and after the reading and compared qualitatively, focusing on changes (if any) in content of memory, particularly emotional. Results indicated more presence of negative emotional content in the second round of memory reports and greater consciousness about how the relationship actually was. The implications for theories of autobiographical memory and retrieval as well as for gender violence interventions are discussed.  
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**The Impact of Meaningful Gestures on Associative and Item Memory.**

ASHLEY S. BANGERT, HECTOR RODRIGUEZ, LAURA RAMOS, ILIANA SOTO, *University of Texas at El Paso*. Gesturing has been shown to facilitate problem-solving and learning. For example, learning of foreign language vocabulary, which requires forming associations between items across languages, benefits from the use of meaningful gestures during study. The goal of the current experiment was to directly examine the impact of creating a personally meaningful gesture on associative and item memory for weakly-associated word pairs. College students were asked to learn one list of word pairs in a condition where they simply studied the pairs and another list of word pairs in a

condition where they created their own meaningful gestures to facilitate learning of the pairings. After the learning phase they completed an associative recognition memory test where they had to distinguish old pairings from new and recombined pairs, an item recognition memory test where they distinguished individual items that comprised the original pairs from new items. Results showed that gesturing during learning impaired people's ability to discriminate recombined from old pairs but improved their ability to recognize new versus old pairs when compared to study alone. Item memory was also better in the gesture condition. These results suggest that while gesturing may impair some aspects of associative memory, this impairment may be driven by its ability to strengthen the representations of individual items in memory during learning. During associative recognition, these strong item representations may simply overwhelm people's ability to attend to the pairing or association between items.

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### The Development of Categorization: Evidence from Category Learning and Recognition Memory.

VLADIMIR SLOUTSKY, WEI (SOPHIA) DENG, *The Ohio State University*.

We examined the development of categorization, with a specific focus on what develops. In three experiments, 4- and 6-year-olds and adults learned categories and then were tested with categorization and recognition tasks. In Experiments 1 participants ably learned the categories, and representational differences transpired between children and adults: adults exhibited better memory for most predictive features, whereas young children remembered well all the features. In Experiment 2, participants' attention was explicitly directed to the most predictive feature, and in Experiment 3, their attention was directed to the less predictive features. Adults' remembered features differentially, according to instructions, whereas young children remembered all the features equally well. Furthermore, their memory for features that were not cued was better than memory for these features in adults. Results of computational modeling indicate that whereas categorization decision in adults are predicted by their representations of the category, in children categorization decision and representations were independent. These results suggest important developmental differences in attention and representation of categories.

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### Positive and Negative Schizotypy Are Associated With Differential Patterns of Episodic Memory Impairment.

LILI SAHAKYAN, THOMAS R. KWAPIL, *University of Illinois at Urbana-Champaign*.

Cognitive impairment is a hallmark of schizophrenia; however, studies have not comprehensively examined such impairments in non-clinically ascertained schizotypic young adults. Studying non-psychotic schizotypes provides a powerful method for examining the expression and development of schizophrenia-spectrum disorders. We employed a series of measures to assess episodic memory in high positive schizotypy, high negative schizotypy, and comparison control group. Consistent with diminished cognitive functioning seen in negative symptom schizophrenia, the negative schizotypy group exhibited deficits on free recall, recognition, and source memory tasks. The positive schizotypy group did not demonstrate deficits on the above mentioned tasks. However, in

contrast to the other groups, the positive schizotypy group showed an unexpected set-size effect on the cued recall task – consistent with heightened spreading activation and reduced executive control suggested to underlie psychotic symptoms. These results are the first to demonstrate that there are long-term memory deficits in a non-clinical sample of participants who scored high on schizotypy dimensions. On some tests, memory deficits emerged only in negative schizotypy, on other tests, the deficits were specific only to positive schizotypy, and yet on some tests, all three groups performed comparably. The findings suggest that the results did not reflect generalized performance deficits in either schizotypy group. They support a multidimensional model of schizotypy and schizophrenia, and suggest that positive and negative schizotypy involve differential patterns of cognitive impairment.

### PICASSO ROOM, SATURDAY 7TH MAY, 11:00-12:40 TS23 Working Memory I

#### Embodying Short-Term Memory: Perceptual-Motor Determinants of Auditory-Verbal Serial Recall.

ROBERT W. HUGHES, *Royal Holloway, University of London*, CINDY CHAMBERLAND, SÉBASTIEN TREMBLAY, *Université Laval*, DYLAN M. JONES, *Cardiff University*.

Four experiments tested the hypothesis that the compatibility between obligatory perceptual organization and the active assembly of a subvocal motor-plan plays a key role in auditory-verbal serial recall. We show first that the classic finding that serial recall is poorer with ear-alternating items is related to spatial-source localization, thereby confirming a basic tenet of the perceptual-motor account and disconfirming an early account based on the notion that the ears serve as two discrete input-channels (Experiment 1). Promoting streaming-by-location of ear-alternating items—such that subjective order perception would be incompatible with objective item-order—augments the ear-alternation effect (Experiment 2) whereas demoting streaming-by-location by reducing the regularity of the alternation attenuates the effect (Experiment 3). Finally, increasing the perceptual variability of an ear-alternating list while demoting the likelihood of streaming-by-location—by adding uncorrelated changes in voice—also reduces the ear-alternation effect as does articulatory suppression for that part of the list (pre-recency) associated with motor-planning (Experiment 4). The results are incompatible with a class of theoretical accounts in which perceptual variability impairs serial recall due to a deficit in encoding items into a limited-capacity short-term memory space and instead support the view that serial short-term memory theory needs to embody, if not focus exclusively upon, perceptual and motor processes.

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#### The Shifting Contents of Visual Working Memory and the Focus of Attention.

GRAHAM J. HITCH, ALAN D. BADDELEY, *University of York*, RICHARD J. ALLEN, YANMEI HU, *North East Normal University China*.

The contents of working memory are constantly changing but despite much research, what controls this flux is still only poorly





understood. We studied these processes in visual working memory using a method of probing the immediate retention of a single object from a short series. As expected the most recent object was best recalled. However, this advantage was removed by an irrelevant “stimulus suffix”, a subsequent object participants were instructed to ignore. Further experiments studied the effect of instructions to prioritize memory for one of the objects. The serial position of this object varied in different conditions. In all cases both the prioritized and most recent objects were recalled best and both objects were vulnerable to suffix interference, the remaining items being unaffected. These observations suggest that a subset of items in working memory occupy a transient, privileged state in which information is instantaneously highly available but subject to rapid turnover. Further results suggest that the privileged state applies to a limited amount of information and is determined by a combination of perceptual attention and central executive control. We identify this transient state with the current focus of attention within the episodic buffer component of working memory.  
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#### **Examining Attentional Refreshing on Episodic Memory.**

VALERIE CAMOS, *University of Fribourg*, SOPHIE PORTRAT, *University of Grenoble*, VANESSA LOAIZA, *University of Essex*, ANNE-LAURE OFTINGER, *University of Fribourg*.

Attentional refreshing is considered as a major maintenance mechanism in working memory (WM), and numerous studies have shown that recall from WM depends on the cognitive load of the concurrent task in complex span tasks (Barrouillet & Camos, 2015, for a review). However, refreshing remains an ill-defined mechanism. To explore the nature of this mechanism, recent studies examined the retention in episodic memory (EM) of information studied in a WM span task. More specifically, Loaiza and McCabe (2012, 2013) showed that increasing the number of refreshing opportunities during a complex span task improves performance in a subsequent delayed recall test. The aim of the present study was to extend this line of research. In two first experiments, the cognitive load of the concurrent task was manipulated by varying either its pace or its nature. As in WM, recall from EM decreased with an increasing cognitive load, while it remained immune to manipulations of the subvocal rehearsal (Camos & Portrat, 2015). Two subsequent experiments orthogonally manipulated cognitive load (through either pace or nature of the concurrent task) and refreshing opportunities. A final experiment aimed at testing a specific prediction of the time-based resource-sharing (TBRS) model by disentangling the cognitive load of the concurrent task, the number of refreshing opportunities and the amount of free time available for refreshing in a complex span task.

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#### **Executive and Perceptual Attention; Separate Determinants of Visual Working Memory.**

RICHARD J. ALLEN, *University of Leeds*, GRAHAM J. HITCH, ALAN D. BADDELEY, *University of York*, YANMEI HU, *North East Normal University, China*.

We report an experimental series examining the role of executive control in stimulus-driven and goal-directed attention in visual working memory. Across two experiments, a demanding concurrent task particularly disrupted memory for items presented earlier in a visual sequence, suggesting executive involvement in retention

while further items are being processed. In the first experiment, addition of perceptual interference in the form of a visual suffix following sequence completion disrupted memory for later sequence items. The disruptive effect of this suffix was independent of executive load. In the second experiment, instructions to prioritise either the first or final item in a sequence led to their improved recall, but this was substantially reduced by increased executive load. These results suggest that while perceptual selective attention can operate relatively automatically in visual working memory, executive control resources play a critical role in enabling active prioritisation of items within a privileged state.

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#### **Mechanisms of Improved Dual-Task Performance in Action-Video Gamers.**

TILO STROBACH, *Medical School Hamburg*, TORSTEN SCHUBERT, *Humboldt University Berlin*.

Recent research has shown that video gamers are improved in different cognitive skills in untrained transfer situations. However, the mechanisms of these improvements are unknown: (1) a single more general level of improvement (Bavelier et al., 2012) or (2) improvements are specific and depends on similarities between the experienced video game genre and transfer situations (Oei & Patterson, 2014). The present study tested these mechanisms for the case of action-video-games and transfer situations with simultaneous dual-tasks: combinations of speeded tasks with predictable or unpredictable task orders, task combinations with high working-memory demands. While the “general” mechanism predicts improvements in all dual-tasks, the “similarity-based” mechanism predicts improvements in speeded dual-tasks; this is because action-video-games are particularly characterized by speeded actions. In action-video gamers in contrast to non-video gamers, we found trends for improvements in all dual-task situations. These findings support the “general” mechanism for the case of action-video-games and dual-tasking.

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ANDALUCIA I & II ROOM,  
SATURDAY 7TH MAY, 15:20-17:00  
**TS24 Applied Cognition**

#### **Investigating the Relationship between Executive Functions and Learning in a Digital Environment.**

GAL BEN-YEHUDAH, LUCHIA KOVALEV, *The Open University of Israel*.

Digital learning environments are becoming more prevalent. Educational institutes are encouraged to use digital textbooks that contain hyperlinks and interactive elements. Learning, however, in such an environment is challenging. It has been proposed that executive functions (EFs) may mitigate the cognitive load associated with digital learning. Here we investigated the relationship between EFs and digital learning in the context of an internet search task. Searching for information involves selection of relevant links from a search list. This often requires resolution of conflicting information presented in the link's title and its description. Based upon findings of superior EFs among bilinguals relative to monolinguals, we also tested the prediction that fluent bilinguals

would be better at link selection in the conflict condition. Thirty-eight monolingual Hebrew speakers and 38 proficient bilinguals accessed webpages from a pre-generated search list, in which half of the links contained conflicting information. They had limited time to select relevant links and study. EFs were assessed with a task-switching paradigm. The results showed successful learning in both groups, but there were no group differences in study outcomes or in measures of EFs. Bilinguals, however, selected more relevant links and they reported less disorientation during learning. Interestingly, across all participants, perceived disorientation during learning was significantly correlated with poor link selection and slower conflict resolution in the task-switching paradigm. These findings suggest a complex relationship between EFs and digital learning. Future studies should delineate the role of specific EFs components in learning in different digital settings.

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### Using Perceptual Similarity Spaces to Predict Classification of Vehicle Sounds.

BRANDON S. PERELMAN, JEREMY R. GASTON, KELLY DICKERSON, *U.S. Army Research Laboratory, Aberdeen.*

Complex environmental sounds can vary along stimulus dimensions that may provide acoustic, perceptual or semantic-level cues to stimulus classification. Because of this, it can be difficult to assign more than superficial explanations to patterns of classification performance, especially when the stimuli in the set share overlapping global properties. Here, we report perceptual similarity ratings for sets of vehicle sounds and use the patterns to predict classification probability for those sounds. In Experiment 1, participants ( $n = 8$ ) provided pairwise similarity ratings for 33 sounds made by approaching prop planes ( $n = 12$ ), jets ( $n = 12$ ), helicopters ( $n = 4$ ), wheeled vehicles ( $n = 8$ ), and tracked vehicles ( $n = 2$ ). These ratings were used to construct a 2D space using multidimensional scaling (MDS). K-means clustering ( $k = 4$ ; determined via silhouette plot) identified four latent clusters in the similarity space. In Experiment 2, the participants completed a classification task in which they were presented with the same set of sounds (10 trials per sound for 330 randomly-ordered trials) and asked to classify the vehicle types. This experiment resulted in a probability associated with classifying a given sound as each vehicle type. Finally, we present a regression model in which stimulus-cluster centroid distances in the perceptual similarity space generated in Experiment 1 significantly predicted classification probabilities found in Experiment 2. These results extend our previous findings in discrimination tasks, and show that perceptual similarity can predict patterns of auditory identification for complex environmental sounds.

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### Smartphone, iPad or PC: Which One Is Better to Watch Your Favourite Subtitled Film?

JUDIT CASTELLÀ, ANDREU OLIVER, OLGA SOLER, *Universitat Autònoma de Barcelona.*

Subtitling is a spread technique used to allow the access to audiovisual content (i.e. news, films, short videos) to deaf, hard of hearing and foreign language learners. Several platforms that differ in size and resolution are available for watching such contents, so research is needed in order to determine whether the amount of visual attention diverted to subtitles and scenes differ across devices, and also to what extent it influences content recall and

comprehension. Thus, the aim of this experiment was to determine how visual attention is diverted as a function of the device. Twenty-two participants took part in the study. Three two-minute clips from a Norwegian film, subtitled in Spanish, were presented in an Apple iPhone 4 (3.5 inches), an Apple iPad Air (9.7 inches) and an Acer Monitor (22 inches). Comprehension and recall were assessed through a questionnaire that included five questions about the verbal content (subtitles) and five questions about the visual content (objects on the scene). Eye tracking data were collected using a Tobii X2-60 eye tracker. We expected to find a different visual exploration pattern as a function of the size of the device: lower fixation count but higher fixation durations on the smallest screen, and higher fixation count but lower durations as the screen size increases. Results are discussed in terms of the different pattern of exploration for each device and also of the relationship between attention distribution and recall/comprehension. Email: Judit Castellà, [judit.castella@uab.cat](mailto:judit.castella@uab.cat)

### Spotting Lesions in a Split of a Second - Neural Mechanisms behind Radiological Expertise.

MERIM BILALIĆ, *University of Klagenfurt.*

Theoretical accounts assume that experienced radiologists have acquired vast knowledge of normal and abnormal radiological images, also called schemas. Once they encounter a new image, they automatically compare it with available schemas, quickly making a global impression of the image. This first impression leads immediately and directly to suspicious regions. Less experienced radiologists lack this knowledge and have in turn much harder time identifying suspicious regions. While these cognitive mechanisms are known, their brain implementation remains a mystery. Here I tackle the neural underpinnings of radiological expertise using the functional magnetic resonance imaging (fMRI). Radiologists were expectedly much better than medical students at spotting lesions in thorax X-rays presented for only 200 milliseconds. However, their performance suffered significantly when the X-rays were presented in the inverted position. This indicates that holistic processes based on acquired knowledge play a crucial role in radiological expertise. Both radiologists and medical students activated a number of brain areas to a similar extent. The differences were, however, specially pronounced in the inferotemporal areas around the fusiform gyrus. Experts showed pronounced activation in this area whereas novices almost lacked any significant activation within the area. The fusiform gyrus is an important region for visual expertise and it hosts the Fusiform Face Area (FFA) that is responsible for face recognition. Face perception requires holistic processing just as thorax X- Rays and it seems that the same area is responsible for both skills.

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### The Attention-Related Driving Errors Scale (ARDES): Available now in English.

C. CASTRO, PEÑA-SUÁREZ E., *University of Granada*, P. VENTSISLAVOVA, *Nottingham Trent University*, A. GUGLIOTTA, *University of Granada*, J. ROCA, LÓPEZ-RAMÓN M.F., *University of Valencia*, J.L. PADILLA, *University of Granada*.

The Attention-Related Driving Errors Scale (ARDES) is a self-reported questionnaire to assess individual differences in proneness to making attentional errors while driving. The aims of the current



work are to adapt the Spanish ARDES to the culture, language, traffic regulations and driving habits of the UK and provide new validity evidence of the cross-cultural equivalence of the scale. An improved forward and backward translation design was used to translate the Spanish ARDES into English. A committee-approach review process was also included in the translation phase to guarantee that the English ARDES was the most appropriate to reflect the language, culture, traffic regulations and driving habits of the UK. A sample of 301 British drivers completed the adapted questionnaire. Descriptive statistics and psychometric properties (corrected item-total correlation, Cronbach's alpha and factor structure) were performed on the data. To obtain further validity evidence, the relationships between the questionnaire scores and socio-demographic variables (age, educational level, driving experience, accident involvement and traffic fines imposed) were analyzed. Factor analysis suggested a single factor that exceeded the parallel analysis criterion and accounted for 33.84% of the total variance. All items showed positive loadings, ranging from .44 to .62, on this factor. The corrected item-total correlation values varied between .25 and .54, indicating that the items had good discriminatory power. Cronbach's alpha coefficient value was .89. The analysis of the relationships between ARDES-UK scores and socio-demographic variables provided further validity evidence of the appropriateness of the adapted questionnaire. In particular, differences in ARDES-UK scores were found between drivers who reported traffic collisions with material damage and participants who did not. In conclusion, the translation design and psychometrics obtained in the current study suggest that the adapted version of the ARDES is a useful tool for evaluating proneness to attentional errors while driving in the British population.

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## ANDALUCIA III ROOM, SATURDAY 7TH MAY, 15:00-17:00 TS25 Attention I

### **Involuntary Attention Improves Visual Working Memory Performance.**

ROGER W. REMINGTON, *University of Queensland/University of Minnesota*, JAMES RETELL, *University of Queensland*.

Our understanding of the role of attention in encoding and retrieval from early visual working memory has come primarily from experiments showing that the identification of briefly presented stimuli can be improved by directing attention to relevant subsets of the stimuli either prior to or after the display. Here we examine if the same advantage accrues to stimuli at locations to which attention has been captured involuntarily when neither the cue nor location provide information about the location or identity of targets. In a change-detection variant of the Yantis & Jonides (1984) paradigm, a set of placeholders is replaced by colored disks (Experiment 1) or colored shapes (Experiment 2) along with an additional abruptly onset stimulus. Subjects indicated if a subsequent probe at one of the locations had the same color as the stimulus previously at that location. Locations were probed with equal probability. Accuracy for items with an abrupt onset was higher than that for other items. An unexpected probe for shape identity showed no advantage for the onset, suggesting that the advantage of attending accrues to only task relevant information. The results are consistent with

other work showing that attention facilitates the extraction of only task-relevant properties. We argue that probing scene knowledge without requiring speeded responses provides an important converging measure of the interaction of exogenous attention with early stimulus processing.

### **The Effect of Learned Predictiveness and Verbal Instructions on Spatial Cueing.**

PEDRO L. COBOS, *University of Málaga, Instituto de Investigación Biomédica de Málaga (IBIMA)*, MIGUEL A. VADILLO, *Primary Care and Public Health Sciences, King's College London*, DAVID LUQUE, *University of Málaga, School of Psychology, UNSW Australia*, MIKE E. LE PELLEY, *School of Psychology, UNSW Australia*.

It has been shown that selective attention is allocated to the best available predictor of an outcome. Mitchell et al. (2012) have shown that instructions about the 'relevance' of each stimulus can influence (and even reverse) the learned predictiveness attentional bias, suggesting that propositional reasoning plays a crucial role in this phenomenon. Our experiment further explores the effects of instructions on this learned attentional bias. As a difference with previous work, we measured attentional capture through spatial cueing effects, which have been found to rely on rapid attentional processes (Le Pelley et al., 2013). Participants responded faster to events presented in the spatial location cued by stimuli that had previously been trained as predictive through trial-by-trial learning. However, verbal instructions regarding relevance failed to modulate the effect of learned predictiveness on spatial cueing. These results suggest that predictive stimuli produce an attentional bias which is not (always) under voluntary control.

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### **Reward Modulation on Attentional Selection.**

ALEXIA BOURGEOIS, PATRIK VUILLEUMIER, *University of Geneva*.

Recent studies suggest that motivational stimuli such as rewards could be a powerful determinant of attentional selection, both in healthy subjects and in brain-damaged patients suffering from neglect. However, the exact mechanisms underlying this processing in the human brain are still poorly known. We developed experiments based on a visual search task in order to better understand how value-based attentional priority could modulate spatial orienting, and where within the cognitive system the signal providing attentional priority is generated. Our results demonstrated that visual stimuli previously associated with a high monetary reward received higher attentional priority in a subsequent visual search task. Interestingly, this effect was observed in healthy subjects as well as in neglect patients when targets were presented in the usually left neglected hemispace. Thus, attentional selection might be counteracted by reward information, independent of conscious control. The anatomical analysis of lesions in neglect patients indicated that the attentional capture induced by previously high rewarded distractors involved mainly the right angular gyrus, as well as of the right posterior cingulum. The anatomical analysis of lesions in neglect patients indicated an involvement of the right angular gyrus, as well as of the right posterior cingulum. Reward signals may thus bias neural activity within key nodes of attentional network, through a common priority map integrating several different top-down influences. These results offer interesting perspectives to explicitly



link attentional orienting and motivational signals within current models of attention. They also open new perspectives that may usefully be exploited for neurological rehabilitation strategies in patients suffering from attentional disorders such as neglect patients.

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### Short or Long Lasting Automatic Activation in the Simon Task: A Model-Based Analysis.

ROLF ULRICH, MATTHIAS KARLBAUER, TERESA BIRNGRUBER, HANNES SCHRÖTER, *University of Tübingen*.

The diffusion model for conflict tasks (DMC; Ulrich, Schröter, Leuthold & Birngruber, 2015, *Cognitive Psychology*) combines conceptual features of standard diffusion models with the notion and of controlled and automatic processes. Specifically, DMC assumes that the activations of these two processes superimpose to trigger the response. DMC can account for a variety of distributional properties in conflict tasks (e.g., Eriksen flanker, Simon, Stroop). In particular, DMC is compatible with all observed shapes of delta functions, including negative-going functions that are especially challenging for most models including standard diffusion models. In this talk, we report two experiments that critically test DMC's assumption that the contribution of automatic processes is short lasting, even when the presence of conflicting information is long lasting. The results support DMC's assumption.

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### Visual Short-Term Memory Load Disrupts Subitizing Limit.

SIMONE CUTINI, *University of Padova*, FRANCESCO SELLA, *University of Oxford*, MARCO ZORZI, *University of Padova*.

Early visual processing is characterized by the parallel elaboration of a massive amount of information, nonetheless the number of objects that can be simultaneously tracked and memorized is surprisingly limited, as observed in visual short-term memory (VSTM). Similarly, in non-symbolic visual enumeration tasks, the rapid, precise and confident judgment of the numerosity of small sets, known as subitizing, is usually limited to few elements; when the subitizing limit is exceeded and serial counting is precluded, enumeration is based on estimation. Here we devised a dual-task paradigm approach to address the nature and the selectivity of the link between subitizing and VSTM. Subitizing capacity was measured through a visual enumeration task, while VSTM was probed using a change detection task; a verbal memory task was used as control condition and a stringent method to evaluate the individual subitizing limit was employed. The load amount of both VSTM and verbal memory was manipulated in order to explore their impact on visual enumeration performance. Our results demonstrate that VSTM load, but not verbal load, modulated performance within the subitizing range without affecting the estimation of larger numerosities. This finding provides converging evidence regarding the presence of two distinct mechanisms specifically associated to subitizing and estimation. Importantly, we found a relation between the amount of VSTM load and the decrement in the number of elements that can be subitized; the trade-off between VSTM load and enumeration accuracy at the subitizing limit strongly suggests that VSTM and subitizing share the same cognitive resources.

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### Attending to and Approaching People in a Large-Scale Virtual Environment: Influences of Stance and Emotional Expression.

PETER CHAPMAN, CHLOE ROBBINS, KATE BAILEY, *University of Nottingham*.

Many theories of social and emotional processing are based on fundamental differences in approach and avoidance motivation but studies have typically measured this indirectly e.g. through questionnaires or by lever pushing/pulling, arm flexion, or joystick manipulation. Such studies are relatively insensitive to the time course of reactions and often conflate attention towards a stimulus with the desire to approach it. This paper reports two studies that measure approach and avoidance directly in a large-scale virtual environment and integrate this with measures of visual attention over a realistic time-course. 56 participants moved through a virtual gallery displayed on a 180 degree hemi-cylindrical projection screen 5 metres in diameter while their eye-movements and motion paths were recorded. At 16 points in the gallery they had to pass life-size photographs of people who varied in their emotional expression (neutral or positive), and orientation (facing the participant with direct gaze, or looking across or away from the participant's path signalled either by eye-gaze, head orientation or body orientation, or else facing directly away from the participant). Eye tracking showed two distinct phases of attention capture, the first when the photograph first became visible and the second associated with a change in motion path approximately 5 metres from the image. Behaviour was moderated by both stance and emotional content. We conclude that it is not possible to understand approach and avoidance without paying attention to the extended time course of this behaviour and its relationship with visual attention.

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MACHADO ROOM,  
SATURDAY 7TH MAY, 15:20-17:00  
TS26 Memory III

### Knowledge Construction Requires Bricks, Not Sand: The Critical Role of Familiar Constituents in Learning.

LYNNE M. REDER, XIAONAN L. LIU, *Carnegie Mellon University*, ALEXANDER KEINATH, *University of Pennsylvania*, VENCISLAV POPOV, *Carnegie Mellon University*. Background:

Despite vast efforts to understand human learning, researchers have failed to appreciate that forming new knowledge is more difficult with less familiar constituents and that more familiar stimuli consume less working memory resources.

Method: Subjects unfamiliar with Chinese characters were trained to discriminate visually similar characters during a visual search task over four weeks during which half of the characters appeared much more frequently. Each week subjects learned novel character pairs associated with different English words with half of the novel pairs using more familiar characters. A final test 2-4 weeks later included an N-Back task (with three levels of N) using blocks of low and high frequency characters.

Results and Conclusions: Ability to recall English words to the associated character-pair improved over weeks but more so for the novel pairs consisting of more familiar characters. Performance on the N-back was better for more familiar stimuli even after controlling for encoding efficiency. Encoding efficiency only





predicted accuracy for low levels of memory load and played no role at higher levels of memory load. In addition, contrary to expectations from the visual search literature, characters that were more visually similar to the search set were found more quickly and accurately as the weeks progressed, demonstrating that learning is better when people have to attend to all features of a novel chunk, instead of depending on partial matching of key features. These results have implications for theories of learning and memory and can be used to improve teaching.

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### **A Doorway onto Episodic Memory: The Role of Spatial Boundaries in Shaping Event Representations.**

AIDAN J HORNER, JAMES A BISBY, AIJING WANG, KATRINA BOGUS, NEIL BURGESS, *University College London*. When remembering the past, we typically recall 'events' that are bounded in time and space. The elements experienced within these bounds are included within an event, and those experienced outside are often excluded. What defines these event boundaries? Previous research has provided evidence for a role of spatial boundaries in the online segmentation of our sensory experience, but it is not known how this spatially-driven segmentation contributes to subsequent long-term episodic memory. Here we show that the presence of a spatial boundary at encoding (a doorway between two rooms) impairs participants' later ability to remember the order in which objects were encountered. A sequence of two objects presented in the same room in a virtual reality environment is more accurately remembered than a sequence of two objects presented in adjoining rooms. Critically, this effect is present despite controlling for both the time and path distance between encountering objects within the same room vs. across adjoining rooms. We therefore provide evidence that, as with short-term working memory, the structure of long-term episodic memory is shaped by the presence of a spatial boundary.

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### **Event Cognition and the Retention Function.**

GABRIEL A. RADVANSKY, *University of Notre Dame*.

This study assessed the availability of information at different serial positions as a function of how the items were organized into events. People were presented with 30 sets of information with the goal of detecting the possibility of people illegally making methamphetamines at a laboratory. Each set included information about (a) a person, (b) their goal, (c) their spatial location, (d) the time period, (e) the activity the person was doing, and (f) the object they were interacting with. After viewing all 30 sets, participants received a recognition test in which people were presented with individual elements from the sets with the task was to indicate whether each element had been encountered before or not. There were four groups of participants in which there were (1) no event boundaries, (2) large event boundaries, (3) small event boundaries, or (4) both. The results revealed a standard retention function for when there were no event boundaries. However, when event boundaries were present, that is the information was stored in separate event models, the retention function was altered. Specifically, the decline memory within an event model was greater than the decline across event models. These results are interpreted in the context of event cognition theory in that memory is influenced by how information is structured into events, not simply how far

back in time the information was encountered.

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### **Is the Levels of Processing effect language specific?**

ALAN D. BADDELEY, GRAHAM J. HITCH, *University of York*. Historically, the study of long-term memory has been dominated by research using verbal material. Web-based access to a wide range of visual stimuli has begun to change this, allowing us to question the generality of verbally based theoretical concepts. We describe a study applying the Levels of Processing framework to memory for door scenes, finding a much reduced effect compared to that found in the verbal literature. A series of further studies demonstrated that this was also true for a range of other visual stimuli selected from specified categories. It also however showed that the levels effect for verbal stimuli was much more varied than previously assumed. We propose an extension of the levels framework emphasising two separable dimensions, perceptual and semantic. Recognition performance based on visual stimuli "affords" rapid and rich encoding of a rich array of cues, regardless of encoding instruction, whereas verbal stimuli are perceptually impoverished, but potentially involve an extensive array of semantic cues, given the appropriate encoding strategy.

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### **Do Mediator Production and Shifts Contribute to the Spacing Effect for Cued Recall? Critical Tests of the Shift Hypothesis.**

JOHN DUNLOSKY, KAYLA MOREHEAD, KATHERINE A. RAWSON, MELISSA BISHOP, *Kent State University*, MARY A. PYC, *Dart NeuroScience*.

When study is spaced across sessions (versus massed within a single session), final performance is greater after spacing. This spacing effect may have multiple causes, and according to the shift hypothesis, part of the effect can be accounted for by a shift in learners' use of strategies. The shift hypothesis proposes that learners who space their study, rather than mass it, will shift strategies across trials and eventually generate mediator-based strategies that are more effective. In two experiments, participants studied paired associates using either a spaced or massed schedule. They reported strategy use for each item during every study trial and during the final test. Consistent with the shift hypothesis, participants who had spaced (as compared to massed) practice reported using more mediator-based strategies on the final test. This use of effective mediators also statistically mediated part of the spacing effect on final performance. The results of the two experiments provide strong evidence that strategy use contributes to the size of the spacing effect.

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PICASSO ROOM,  
SATURDAY 7TH MAY, 15:20-17:00  
**TS27 Working Memory II**

**Digit Span, Nonword Repetition, And Sentence Repetition: Why Popular Tests of Verbal Short-Term Memory Measure Associative Learning.**

GARY JONES, *Nottingham Trent University*, BILL MACKEN, *Cardiff University*. Performance on three principal measures of verbal short-term memory – digit span, nonword repetition, and sentence repetition – have implicated phonological working memory across a range of tasks in psychology. However, all of these tasks are known to have a long-term influence, the contribution of which is ostensibly minimised by the removal of familiar items (e.g., 1-2-3, **stopogratic**). We argue against this general approach by showing both experimentally and computationally how digit span, nonword repetition and sentence repetition are strongly influenced by long-term associative learning gained from natural language exposure, despite attempts to reduce the contribution of such effects. This work shows how the role of phonological working memory is exaggerated on the basis of performance in all three tests and strongly questions their ability to measure verbal short-term memory. The results show that short-term storage is intrinsic to the task at hand, suggesting a reconceptualisation of verbal short-term memory as inextricably linked to other task processes.

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**Working Memory Capacity and Fixed Versus Variable Complex Operation Span Tasks.**

GEORGINA ANNE TOLAN, CRYSTAL KENNEDY, *Australian Catholic University*, GERALD TEHAN, *University of Southern Queensland*.

The complex operation span task is a widely used measure of working memory capacity (WMC) in which participants are required to remember a number of list items whilst completing mathematical operations (Conway et al, 2005). The number of to-be-remembered items increases from two to five, with the shorter spans doing little to challenge WMC and differentiate variability in WMC (Conway et al, 2005); however as the list length increases towards five, individual differences become more apparent. This research attempted to examine the test-retest reliability and correlations with fluid intelligence, of a modified operation span task in which the list length was fixed at five items and compared with lists that varied in length. Sixty participants completed the operation span task on two occasions. The Raven's Advanced Progressive Matrices (Raven, 1990), a measure of fluid intelligence, was also administered during the first testing session. Results indicated that recall performance on the fixed length task was equivalent to that of the variable length task. However the fixed length task appeared to be a better predictor of fluid intelligence.

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**Object Non-specific Binding of Non-spatial Features in Visual Working Memory for Moving Objects.**

JUN SAIKI, *Kyoto University*.

Binding of non-spatial features in visual working memory, and the role of spatiotemporal location in binding, remains unknown. Object file theory postulates that spatiotemporal location is critical in maintenance of feature binding. By combining the redundancy gain paradigm and the object reviewing paradigm, evidence for the location invariant binding of non-spatial features has been reported. However, this work used sets of stationary objects, thus whether even moving objects show the same effect remains unknown. A set of features was presented in a two-object memory display, followed by a single object probe. As in the object reviewing paradigm, frames may move during the retention interval. Participants judged if the probe contained any features of the memory display, regardless of their locations. The probe contained two, one, or zero features in the memory display (redundant trials, single-feature trials, or new trials, respectively). Within the redundant trials, the features were either grouped or separated. The role of objectness was investigated by comparing object-shared and object-unshared trials. The race model analysis of the redundancy gain in RT revealed object-based feature co-activation regardless of object sharing between memory and probe displays, suggesting object non-specific binding of color and shape. Object-sharing benefits were obtained for both redundant and single-feature conditions, indicating maintenance of object files independent of non-spatial feature binding. Regardless of objects' motion, color-shape binding is formed only when features are grouped in memory encoding, but becomes unbound from the object during the maintenance period, inconsistent with the object file theory.

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**The Pre-Categorical Nature of Visual Short-Term Memory.**

PHILIP T. QUINLAN, *The University of York*, DALE J. COHEN, *The University of North Carolina at Wilmington*.

We conducted a series of recognition experiments that assessed whether visual short-term memory (VSTM) is sensitive to shared category membership of to-be-remembered (tbr) images of common objects. In Experiment 1 some of the tbr items shared the same basic level category (e.g., hand axe): Such items were no better retained than others. In the remaining experiments, displays contained different images of items from the same higher-level category (e.g., food: a bagel, a sandwich, a pizza). Evidence from the later experiments did suggest that participants were sensitive to the categorical relations present in the displays. However, when separate measures of sensitivity and bias were computed, the data revealed no effects on sensitivity, but a greater tendency to respond positively to non-category items relative to items from the depicted category. Across all experiments, there was no evidence that items from a common category were better remembered than unique items. Previous work has shown that principles of perceptual organization do affect the storage and maintenance of tbr items. The present work shows that there are no corresponding conceptual principles of organization in VSTM. It is concluded that the sort of VSTM tapped by single probe recognition methods is pre-categorical in nature.

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### Oscillatory Correlates of Visual Working Memory Uploaded from Long-Term Memory.

KEISUKE FUKUDA, GEOFFREY F. WOODMAN, *Vanderbilt University*.

Visual working memory (VWM) allows us to represent a limited amount of visual information in the service of current tasks demands. To study VWM, studies thus far have almost exclusively examined situations in which new visual inputs are maintained. However, it is unclear how visual information is maintained in VWM when it is retrieved from visual long-term memory (VLTm). In this study, we first had participants learn spatial layouts of colored objects that varied in their set size (i.e., 1 2 4 or 8 objects). Then we presented a letter cue associated with each array and had participants retrieve and maintain the learned array while we recorded their electroencephalogram (EEG) to examine previously established neural correlates of VWM. We found that an oscillatory correlate (i.e., posterior alpha power modulations, Fukuda, Mance & Vogel, 2015) dissociated the set sizes of the learned arrays by mirroring the pattern observed when VWM stored new visual inputs. That is, when participants were accessing the learned arrays, the alpha band power showed a monotonic decline up to the set size 4 with no further decrease for larger arrays. Furthermore by using this oscillatory correlate, we also demonstrated that participants were capable of partial retrieval as well as additive retrieval of learned visual information. These findings suggest that visual information retrieved from VLTm is represented by the same neural dynamics as maintaining new visual inputs, and therefore support classic theories proposing that information retrieved from VLTm is represented in VWM, similar to new visual inputs.

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ALBENIZ ROOM,  
SATURDAY 7TH MAY, 15:20-17:00  
**TS28 Judgement I**

### Are Statistical Judgments Better When Based On More Data?

NIGEL HARVEY, *University College London*, ZOE THEOCHARIS, *University College London*.

Statistical estimates of means, variances, and other features of data improve as sample size increases. With more data, estimates become less variable and samples less biased. If people operate as intuitive statisticians or as 'naïve intuitive statisticians', they should also make better statistical judgments when given more data. Previous studies have shown the expected effects of sample size in some cases but not others. Pollard (1984) concluded: "On the basis of these often conflicting results, there is insufficient support for the Peterson and Beach idea that descriptive tasks can be viewed as tasks on which subjects make inferences that are properly influenced by sample size". We asked people to make judgmental forecasts from graphically presented time-series. Two experiments revealed a U-shaped relation between forecast accuracy and sample size. Accuracy was lowest for series of intermediate length (e.g., five items) but increased as series were made both longer (up to 40 items) and shorter (down to one item). We argue that, with very short series, people use a pattern-independent heuristic, such as the mean or the naïve forecast (i.e. the last data point). With longer

series they use pattern-based heuristics but extraction of pattern parameters is poorer when there are fewer items in the series. Consequently, pattern-based forecasting from intermediate length series is worse than pattern-independent forecasting from short series. More data do not always improve judgment accuracy.

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### Adaptive Anchoring Model: How Static and Dynamic Presentation of Time Series Influence Judgments and Predictions.

PETKO KUSEV, *Kingston University London*, PAUL VAN SCHAİK, *Teesside University*.

When attempting to predict future events, people commonly rely on historical data. One psychological characteristic of judgmental forecasting of time series, established by research, is that when people make forecasts from series they tend to underestimate future values for upward trends and overestimate them for downward ones, so-called 'trend-damping' (modeled by anchoring on, and insufficient adjustment from, the average of recent time series values). Events in a time series can be experienced sequentially (dynamic mode) or they can also be retrospectively viewed simultaneously (static mode), not experienced individually in real time. In one experiment, we studied the influence of presentation mode (dynamic and static) on two sorts of judgment: (i) predictions of the next event (forecast), and (ii) estimation of the average value of all the events in the presented series (average estimation). Participants' responses in dynamic mode were anchored on more recent events than in static mode for all types of judgment but with different consequences; hence dynamic presentation improved prediction accuracy, but not estimation. These results are not anticipated by existing theoretical accounts; we develop and present a model - the Adaptive Anchoring Model (ADAM) to account for the difference between processing sequences of dynamically and statically presented stimuli (visually presented data). ADAM captures how variation in presentation mode produces variation in responses (and the accuracy of these responses) in both forecasting and judgment tasks.

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### Working Memory and Spatial Judgments: Cognitive Load Increases the Central Tendency Bias.

SARAHR. ALLRED, *Rutgers University-Camden*, L. ELIZABETH CRAWFORD, *The University of Richmond*, SEAN DUFFY, JOHN SMITH, *Rutgers University-Camden*.

Previous work demonstrates that memory for simple stimuli can be biased by information about the distribution of which the stimulus is a member. Specifically, stimuli with values greater than the distribution's average tend to be underestimated and stimuli with values less than the average are overestimated. This is referred to as the central tendency bias. This bias has been explained as an optimal use of both noisy sensory information and category information. In a largely separate literature, cognitive load (CL) experiments attempt to manipulate the available working memory of participants in order to observe its effect on choice or judgments. In our two experiments, we examine the effect of CL on the degree to which category information influences stimulus estimates. We employed the CL manipulation by asking participants to remember a long string of numbers (high load) or a short string of numbers (low load) while they observed and reproduced a number of lines

that varied in length. On each trial, participants were asked to remember the number and then were shown a target line. After a delay, they reproduced the length of the target line using an adjustable line. Once they were satisfied with the length of their reproduction, they then reported their memorization number. In two experiments, we demonstrate that participants under a high cognitive load exhibit a stronger central tendency bias than when under a low cognitive load. Although not anticipated at the outset, we also find that judgments exhibit an anchoring bias.

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### Knowing-It-All But Still Learning: Perceptions of One's Own Knowledge and Belief Revision.

SARA HAGÁ, *University of Lisbon*, KRISTINA R. OLSON, *University of Washington*.

Our lay theories suggest that people who are overconfident in their knowledge, are less likely to revise that knowledge when someone else offers an alternative belief. Similarly, we might assume that people who are willing to revise their beliefs, might not be very confident in their knowledge to begin with. We conducted 2 studies that call these lay theories into question. In Study 1 ( $N = 80$ ), we asked children aged 4 to 11 years and college students about familiar (e.g., green) and unfamiliar (e.g., chartreuse) color names. In Study 2, we asked participants of the same age groups ( $N = 80$ ) about familiar (e.g., brush), unfamiliar (e.g., rug beater), and apparently familiar (e.g., hammer-shaped chocolate) objects. In both studies, participants had the opportunity to keep or revise their original answers, after seeing how a peer answered the same questions. Young children were simultaneously more overconfident in their knowledge (e.g., that they knew what chartreuse meant) and more likely to revise their initial beliefs (e.g., to choose another color after seeing a peer choose a different color), than older children and adults. We discuss the potential causes and functions of this dissociation between the confidence with which beliefs are held and the revision of those beliefs across development.

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### The Relative Influence of Perception and Memory in Producing the Central Tendency Bias.

SEAN DUFFY, JOHN SMITH, and SARAH ALLRED, *Rutgers University, Camden*.

Two experiments test the effect of memory and perception on estimates of categorized stimuli. When recalling stimuli, people combine inexact memories of stimuli with information about the distribution in which they are embedded, resulting in a central tendency bias. Experiment 1 explores the role of memory in producing this bias. Participants ( $N=44$ ) completed a line estimation task where they viewed target lines on a computer and reproduced their length by adjusting a second line to equal the target. *Memory condition* participants saw the target line, which disappeared and had to reproduce its length from memory. *Perception condition* participants adjusted the second line while the target line was still present. Using dummy variable regression we examined *bias* (over or underestimating the reproduction length) by *actual stimulus size*, we found that participants in the memory condition had stronger negative slopes ( $\beta = -0.20$ ) and larger intercepts ( $\beta = 30.1$ ) than in the perception condition (perception condition as reference category). The omnibus analysis was significant [ $F(3, 34) = 206.12$ ,  $p < .001$ ] as were coefficients for both intercept and slope ( $p < .001$ ).

In Experiment 2 we tested the effect of target presentation time on estimates. Participants ( $N=74$ ) viewed target lines for either 32, 64, or 128 milliseconds under a white noise mask, then reproduced their length. We found presentation time did not affect the slope or intercepts of the bias by actual size in these three conditions. We discuss the relative role of memory and perception in producing the central tendency bias.

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## ANDALUCIA I & II ROOM, SATURDAY 7TH MAY, 17:20-19:00 TS29 Social Cognition

### N-Equality: More People, Less (Concern for) Equality?

STEPHEN M. GARCIA, *University of Michigan*, AVISHALOM TOR, *University of Notre Dame*.

Do inequality concerns and, therefore, inequality aversion diminish with group size? Concerns over economic inequality in particular play a central role in debates over law and public policy in areas ranging from taxation and regulation to the scope and nature of the modern welfare state. The present studies contribute to inequality research by examining whether people's willingness to tolerate inequality depends in part on the number of recipients of the resources to be distributed. Building on our earlier *N-Effect* findings that show how social comparison and competitive motivation decrease as the number of competitors increases (Garcia & Tor, 2009; Tor & Garcia, 2010; Garcia, Tor, & Schiff, 2013), we find that as the number of recipients increases social comparison-based concerns about relative outcomes diminish, thereby increasing tolerance for inequality. Study 1 analyzed faculty salary data from 5,327 faculty members of the entire University of Texas system, finding that the variance of salaries within an academic department positively correlates with department size. Study 2 employed a between-subjects design, asking participants to choose between allocations among groups of recipients while varying the number recipients across the two conditions, finding participants preferred the equal payoff significantly more in the small- $N$  condition than in the larger- $N$  one. Study 3 related the effect of  $N$  on inequality concerns to social comparison, shedding further light on the mechanism underlying the effect. Together, these findings bear important implications for policy, practice and research on inequality.

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### Effects of Preceding Context on Conscious Face Perception.

SHEN-MOU HSU, JHAO-RONG WU, *National Chengchi University*.

How an external piece of information gains access to conscious processing has been one of the central issues in the literature. However, the role of preceding context on conscious perception is still poorly understood. In this study, participants were instructed to view a briefly presented masked face from trial to trial, such that they were able to recognize the identity of target faces (conscious face identification) in some trials, but were only able to detect the presence of the targets (conscious face detection without





identification) in some other trials, and not able to detect the presence of the targets in the rest of trials. The behavioral results showed that the performances of both conscious face identification and detection were biased by the preceding context shaped by preceding responses. Specifically, participants were more likely to respond not consciously perceiving targets when they made the same responses (not seeing the targets) in preceding trials. MEG data provided further evidence and revealed that preceding contexts, as shaped by preceding responses, differentially modulated phase clustering before the presentation of the target faces. Intriguingly, those contextual effects were independent of preceding stimulus types. The overall findings thus suggest that conscious perception is affected by preceding context. Furthermore, the context provided by preceding responses instead of preceding stimuli may slant current conscious judgement toward assimilative consequences.

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### **Cooperation and Punishment: Effects of Facial Appearance and Facial Expression.**

RAOUL BELL, LAURA MIETH, AXEL BUCHNER, *Heinrich Heine University Düsseldorf*. Facial cues are used to form first impressions of strangers. People make trustworthiness judgments based on facial appearance alone. According to Brown and Moore (2002), the punishment of misleading signals of prosociality serves to increase signal reliability. In the present study, we directly examined how cooperation and punishment are influenced by facial impressions. Participants played a prisoner's dilemma game with interactants who either had a likable or unlikable facial appearance (Experiment 1), or either had a smiling or neutral facial expression (Experiment 2). A multinomial model was used to distinguish between four types of punishment: moralistic punishment, antisocial punishment, hypocritical punishment and irrational punishment. Facial likability and smiling increased the global amount of punishment imposed on uncooperative interactants. This effect was indirect rather than direct: it was solely due to an increased willingness to cooperate with likable-looking and smiling individuals, which in turn provided more opportunity for moralistic punishment (the most common form of punishment observed in our experiments). Smiling even decreased the average strength of punishment imposed on the interactants, suggesting that it may serve as a form of appeasement. The results have implications for theories about how facial emotions are used in social exchange.

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### **Here's Looking at You: The Effect of Facial Motion and Gaze Shifts on Judgements of Attractiveness.**

FIONA N. NEWELL, PIK KI HO, ZORA KNAUF, *University of Dublin, Trinity College Dublin*, ANDREW T. WOODS, *Xperiment. mobi, Surrey*, HANNI KIISKI *University of Dublin, Trinity College Dublin*.

Eye gaze direction facilitates social attention and the perception of facial expressions, but it is also an important determinant for the aesthetic evaluation of faces. Typically, studies on facial attractiveness report that images of faces with direct eye gaze on the observer are preferred over images of the same faces with averted gaze. However, in the natural world, the eyes are constantly in motion and these dynamic changes can often occur with rigid (viewpoint) or non-rigid (expression) changes of the face. In a series of experiments, we investigated how eye gaze direction affects the

attractiveness ratings of an unfamiliar face when an expression change occurred (Experiment 1) or across full or  $\frac{3}{4}$  views of the face (Experiment 2). First, we found that faces in which there was an eye gaze shift towards rather than away from the observer were rated as more attractive, particularly when an expression changed from neutral to smiling. The lowest ratings were provided when the eye gaze shifted towards the observer but when the expression changed from smiling to neutral. Second, for neutral faces only, we found that head orientation affected the benefit of eye gaze: faces were rated as more attractive when turned slightly away from the observer, irrespective of eye gaze shifts, although gaze shifts towards the observer were less attractive in a full-face view. Our results suggest that perception of eye gaze for expression or social attention may not be independent from the information eye gaze provides for the aesthetic judgements of faces.

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### **Investigating the Neural Correlates of Affiliation Based on Shared Aesthetic Preferences.**

HARRY FARMER, ANTONIA HAMILTON, *University College London*.

Discovering that other people share similar preferences to ourselves has been demonstrated to lead to increased judgments of both similarity and affiliation. At present however there has been little investigation of the neural basis of learning about shared preferences or the pathways by which such shared preferences influence judgments of affiliation. We investigated this question in a functional MRI study of 25 adults between the ages of 18 and 40. During the study participants made judgments about which of two pieces of artwork they preferred and then saw the decisions of two confederates. Unknown to the participants the decisions of the confederates were manipulated such that one of them agreed with the participants choice in 75% of trials while the other agreed in only 25% of trials. Participants completed 80 trials overall and rated the confederates on their similarity and likeability after every 20 trials. Behavioural results showed that participants rated the similar choice confederate as more similar to them and likeable than the different confederate. Analysis of the fMRI data showed that observing the different compared to similar confederate led to greater activation in a number of areas heavily linked to social learning and the representation of value including bilateral orbitofrontal and bilateral medial prefrontal cortices. These findings shed light on how we form judgements of others based on our knowledge of their personal taste.

ANDALUCIA III ROOM,  
SATURDAY 7TH MAY, 17:20-19:00

## TS30 Perception

### The Time Course of Three-Dimensional Object Recognition in Human Vision Revealed By High-Density ERPs.

CHARLES LEEK, ZOE OLIVER, MARK ROBERTS, FILIPE CRISTINO, *Bangor University*, ALAN PEGNA, *University of Queensland*.

**Objectives:** While some kinds of image classification occur as quickly as 120ms post-stimulus onset (Thorpe et al., 1996, Nature), we know relatively little about the time course of different perceptual processes involved in 3D object recognition. **Methods:** We investigated this issue using 1000 Hz, 64 channel event-related potentials (ERPs). Participants completed a perceptual matching task requiring shape equivalence judgments about two sequentially presented 3D multi-part novel objects. Trials could contain either two identical objects or two different objects. There were three types of different object trials: Stimulus pairs could share volumetric parts but differ in spatial configuration, contain different volumetric parts but share spatial configuration or share neither parts nor spatial configuration. **Results:** Analyses of the ERP waveforms showed no differences between conditions on the early P1 component – indicating that the conditions were similar in terms of low-level image properties. In contrast, we found evidence of differential sensitivity to volumetric part and spatial configuration overlap in the different response trials on posterior electrodes. This was reflected in amplitude modulations of negative deflections on the N1 component between different object conditions approximately 170ms post-stimulus onset. These differences suggest an early perceptual sensitivity to shared spatial configuration but not local part structure. **Conclusions:** The results are consistent with the operation of two parallel processes during shape perception: a fast, coarse spatial scale, analysis of 3D shape configuration, and a slow, fine spatial scale, analysis of local part structure.

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### Bound Together: Crossing Event Boundaries Alters Perception of Temporal Grouping.

ASHLEY S. BANGERT, OMAR CARRASCO, *University of Texas at El Paso*, CHRISTOPHER A. KURBY, *Grand Valley State University*.

People segment the constant stream of everyday experience into meaningful spatiotemporal events. At the boundaries between these events, memory updating ensures that one can develop an accurate representation of what is happening in the present moment. The current study explored how event segmentation influences people's ability to temporally group items together. Sixty-one college-aged participants watched movies of people engaged in everyday activities, and they were periodically presented with three tones (Tones A, B and C) presented at equal temporal distances (e.g. 5 seconds occurred between each tone). An event boundary occurred either between Tones A and B or between Tones B and C. After the tones were presented on a trial, the movie paused and participants judged whether Tone B was closer to Tone A or to Tone C. Results showed that Tone B was considered closer to Tone A or Tone C if

it occurred within the same event. In other words, tones which had no event boundary crossing between them were considered closer together than tones that were separated by an event boundary. This suggests that memory updating at event boundaries alters the perception of temporal grouping such that subsequent tones that occur within the same event are bound together in memory while subsequent tones that are separated by an event boundary are not.

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### Temporal Integration of Visual-Auditory Stimuli in Autism Spectrum Disorder.

C. ELLIE WILSON, DAVID SALDAÑA SAGE, *University of Seville*.

#### Introduction

Diagnostic criteria for Autism Spectrum disorder (ASD) include difficulties in social-communication, repetitive behaviours, and atypical sensory experiences. Deficits integrating visual-auditory stimuli could affect higher-order domains such as speech and gesture perception. We investigated this using a visual preference paradigm.

#### Methods

Eye-movements were recorded whilst 12 ASD children (4-9 years) and 16 controls (4-10 years) viewed 25 trials of two identical video clips side-by-side: one synchronised to the auditory stimulus and one desynchronised by 80-1200ms. There were 5 conditions: flash-beep; clapping hands; counting; story-telling; xylophone playing. Receptive language ability, non-verbal IQ and degree of autistic traits were also measured.

#### Results

Across conditions, participants showed a marginal preference for viewing synchronised compared to desynchronised videos (ASD: 44% & 41%; Non-ASD: 42% & 40%). Within-group (synchronised vs desynchronised) and between group (ASD vs non-ASD) comparisons were non-significant. The largest discrepancies were in 'flash-beep' (42% & 36%) and 'story-telling' conditions (45% & 39%). Correlation analyses between viewing time ratios (synchronised:desynchronised), receptive language and non-verbal IQ, and autistic traits, revealed a significant positive correlation between story-telling ratio and autistic traits confined to the non-ASD group ( $r=0.56$ ,  $p=0.02$ ).

#### Conclusions

Results suggest more prominent autistic traits in control children was associated with better detection of desynchrony. A trend towards ASD participants having a superior ability to detect desynchronised stimuli complimented this finding. It is possible children with ASD may be hyper-sensitive to multi-sensory desynchrony.

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### Asymmetry of Boundary Extension Errors in Different Facial Parts.

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Previous studies have demonstrated boundary extension false memory error, in which people remember seeing visual images as extending beyond their actual visible boundaries. Furthermore, research have shown the asymmetry in boundary extension, e.g., a larger extension in the direction of the implied motion (Hubbard, Hutchison, & Courtney, 2004). The current research examined false memory errors during the recognition of cropped photographs with emotional faces. Participants (N=84) were tested individually



and completed either a short-term or a long-term condition of the memory task. During the encoding stage, participants observed 24 photographs of faces, cropped either in a forehead or in a chin area, and subsequently they performed face recognition through a forced choice selection. The recall choices included faces with two extended and two reduced crops (representing different degrees of possible boundary extension and boundary reduction errors), so none of the answer options was the same as an image presented during the encoding. Eye-tracking data (using Tobii TX300 Eye Tracker) was collected alongside with the task performance data (mouse clicks on the selected pictures). The results demonstrated robust boundary extension effect in both conditions, revealed by both performance and eye-tracking measures. Furthermore, current findings demonstrated significantly more pronounced boundary extension errors for a forehead than for a chin face area. The current findings provide new evidence on asymmetry in boundary extension. They are discussed in the light of possible cognitive mechanisms of boundary extension phenomenon and are related to the portrait composition rules in photography and visual arts.

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### **The Spatial Precision of Attentional Control is determined by Center-to-Center Distance between Objects without Regard to Edge Overlap.**

CATHLEEN M. MOORE, *University of Iowa*, ELISABETH HEIN, *University of Tübingen*, GERHARD RINKENAUER, MARC GROSJEAN, *Leibniz-Institut für Arbeitsforschung*.

The precision of visual attentional control was assessed using an "attentional walk task." Circular arrays of identical disks that varied in density (the number of disks in the array) were used. One disk was cued with a flash, directing attention to that disk, followed by a variable number of tones. Observers were instructed to shift attention covertly to the next disk in the array (clockwise or counter-clockwise) coincident with each tone. Observers reported on which disk the "attentional walk" ended following each trial. Performance was excellent at low densities and poor at high densities, revealing specific limits in the spatial precision of covert attentional control. Here we asked whether it is the edge-to-edge distance or the center-to-center distance between stimuli that sets the limit on spatial precision. The number of discs in an array was held constant, while the size of the discs varied across trials. Thus, while center-to-center distance was constant, edge-to-edge distance varied with disc size. In extreme conditions, discs were large enough that they overlapped. Performance was determined almost entirely by center-to-center distance, not edge-to-edge distance. This implies that attention is shifted within representations in which stimuli have been parsed and organized into perceptual units ("objects") rather than within a purely retinotopic representation of contrast edges as would be implied if the limit depended on visual (spatial) acuity.

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## **MACHADO ROOM, SATURDAY 7TH MAY, 17:20-19:00 TS31 Forgetting**

### **Are Stressed Out Students Motivated to Forget Mathematics after Class Is Over?**

GERARDO RAMIREZ, *University of California*, IAN M. MCDONOUGH, *University of Alabama*, JIN LING, *University of California*.

The ability to retain and readily access educationally-relevant content from memory is critical for students at all stages in schooling. Unfortunately, some students might have a strong motive or desire to intentionally forget course content once the class has ended – what is termed motivated forgetting (Anderson, 2014). Students may be particularly driven to forget anxiety-arousing memories in an effort to protect their sense of self-integrity or identity (Dalton & Huang, 2014; Sedikides & Green, 2000). If this were the case, then students who experience substantial stress during a class central to their identity might be particularly vulnerable to motivated forgetting.

We tested this hypothesis by recruiting students from a college course on multivariate calculus. Students were asked to report their affective experience once a week during the quarter to measure stress. Forgetting rate was assessed by comparing students' final exam performance against their performance for the same final exam two weeks later during the summer. We find that among students with higher mathematics identity, a higher amount of weekly stress about the course was associated with greater student forgetting of course content ( $\beta = -.771$ ,  $t = -2.07$   $p = .040$ ) and higher report that they avoided thinking about the course ( $\beta = .687$ ,  $t = 1.99$ ,  $p = .048$ ). Neither association was found among students with lower mathematics identity. Our results provide evidence that, in a real classroom, affective and motivational forces shape why students sometimes forget education-relevant content.

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### **Does Background Context Attenuate Item-based Directed Forgetting?**

WILLIAM E. HOCKLEY, NICOLE BURGESS, *Wilfrid Laurier University*, KATHLEEN L. HOURIHAN, *Memorial University*.

Two different effects of context reinstatement can be observed in tests of recognition memory. *Context-dependent recognition* is seen as an increase in both hit and false alarm rates when items are tested in an old study context compared to a novel context. *Context-dependent discrimination* is evidenced when the hit rate is greater for targets tested in their same old study context compared to a different old study context, and is assumed to be based on the encoding of item-context associations. Context-dependent recognition is typically observed when the background context is encoded incidentally, whereas context-dependent discrimination usually occurs when study instructions emphasize the interactive encoding of the context and target items. We examined the effects of context (picture backgrounds) on the recognition of to-be-remembered and to-be-forgotten words in the item-based directed forgetting procedure. A robust directed forgetting effect was observed. Both context-dependent recognition and context-dependent discrimination were found for to-be-remembered items, with the latter effect being more robust when context was intentionally encoded. Context-

dependent recognition was also observed for to-be-forgotten words when context was encoded incidentally, and an effect of context-dependent discrimination emerged when context was intentionally encoded. The results show that context reinstatement can attenuate item-based directed forgetting, and provide a demonstration of the incidental encoding of item-context associations.

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### Learning When You Are Trying to Forget: Implicit Learning in the Directed Forgetting Paradigm.

LEONEL GARCIA-MARQUES, DIANA ORGHIAN, JOÃO BRAGA, *Faculdade de Psicologia Universidade de Lisboa*.

In this presentation we explore the link between implicit conceptual learning and directed-forgetting effects (DFE). We employed an item method directed forgetting paradigm where two different colors schematic faces were presented overlapped and while only one was to be attended by the participants both of them were tested in the recognition test. The attended-to-be-remember attended to-be-forgotten, unattended to-be-remembered and the unattended to-be-forgotten items all belonged to 4 different categories. We found 1) that the DFE only occurs with the attended items and not with the unattended and 2) the conceptual learning occurs for the items from the category of the attended to-be-remembered items and not for the items from the category of the to-be-forgotten items and the reverse happens for the unattended items, i.e., implicit learning in the forget condition and not in the remember condition.

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### The Fate of Distractors in Working Memory: Active Removal or Passive Decay?

PIERRE BARROUILLET, ISABELLE DAGRY, *University of Geneva*.

In working memory span tasks involving the maintenance of memory items while processing distractors, recall performance increases as the cognitive load (CL) of the concurrent activity (i.e., the proportion of time during which it occupies attention) decreases. The TBRS model (Barrouillet & Camos, 2015) accounts for this CL effect by assuming that memory traces suffer from a temporal decay during processing, but are refreshed when attention is available anew. A low CL involves better immediate recall due to the increased proportion of time available to reactivate memory traces and counteract decay. Other theories like SOB-CS (Oberauer et al., 2012) deny any temporal decay or active maintenance of memory traces. Forgetting would result only from interference. Low CL would involve better recall because more time is available to actively remove distractors from working memory and reduce the interference they create. In four experiments, participants performed a complex span task in which the CL of processing was varied, and at the end of the session an unexpected recall or recognition of the words studied as memory items or processed as distractors in the complex span task. In all the experiments, lower CL elicited better delayed recall or recognition of memory items, but left unaffected recall or recognition of distractors. These findings suggest that the better immediate recall of memory items in complex span tasks does not result from a more efficient removal of distractors, but from a better reactivation of memory traces while distractors are disregarded and passively decay.

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### Pay No Attention To That! The Effect of Attentional Control Instructions on Eye-Movements and Memory for Emotional Images.

KATE BAILEY, LAUREN HATCHER, PETER CHAPMAN, *University of Nottingham*. While forgetting is often viewed simply as a memory failure, there are some occasions when we may prefer to forget. In cases where information is superfluous, or an experience is unpleasant, we may wish to choose not to remember; in other cases, we may be directly instructed that certain material can be dismissed. An important way in which we might choose to control our memory is by selectively allocating our attention towards the relevant information and away from the irrelevant. However, it is not clear how effective these attentional strategies are in controlling memory, nor whether emotional information might resist our attempts. To address these questions, the current study presented screens of multiple picture stimuli which varied in their emotional content (positive, negative, neutral). On each screen, images of two valence types were displayed simultaneously. While viewing, participants had their eye-movements monitored, and were directed to either attend to or avoid certain types of images based on their valence (e.g. 'avoid negative images'). Following this, participants' memory for the images viewed was tested using a recognition task. Eye-movement data showed a clear difference between the initial orientation of attention, which was moderated by emotion but relatively insensitive to instructions, and subsequent engagement, which was dramatically influenced by attentional instructions but paradoxically highest for neutral stimuli. Whilst attentional instructions clearly influenced subsequent memory, emotional influences on memory were relatively small. These findings suggest that controlling memory is more effectively achieved with instructions to attend to items than with instructions to avoid.

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PICASSO ROOM,  
SATURDAY 7TH MAY, 17:20-19:00  
**TS32 Cognitive Aging I**

### Automatic Memory Processes in Older Adults with Mild Cognitive Impairment.

AGNIESZKA NIEDZWIENSKA, *University of Hertfordshire/Jagiellonian University*, LIA KVAVILASHVILI, *University of Hertfordshire*.

Mild Cognitive Impairment (MCI), a transitional state between normal ageing and dementia, is characterized by the presence of a cognitive deficit in an otherwise healthy elderly individual. In two studies, we focused on clarifying which specific type of memory processing was particularly disrupted in MCI, and so could serve as an early marker of cognitive decline. We wanted to verify and extend a novel and counterintuitive finding by McDaniel et al. (2011) that MCI primarily penalized automatic memory processes. Study 1 used the prospective memory paradigm (PM) in which participants had to remember to perform intended action when the target event appeared. We compared PM in 44 MCI individuals and 44 healthy older adults across the task parameter that was crucial for the automatic/strategic retrieval distinction (target event focality). As predicted, the PM decline in MCI was more pronounced for focal tasks that were based on automatic retrieval than for non-focal tasks





requiring strategic retrieval. Study 2 investigated, for the first time, whether MCI individuals differed from healthy older adults on the frequency of involuntary autobiographical memories experienced during a monotonous laboratory task. These are memories which are automatically recalled in response to identifiable triggers. Among all spontaneous thoughts recorded by 24 MCI individuals and 24 healthy older adults, it was only involuntary memories that were experienced less often by the MCI group. Both studies consistently demonstrated substantial deficits in automatic processing in MCI. Implications of the results for explaining the nature of cognitive deficits in old age will be discussed.

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### **On Teaching Old Dogs New Tricks: Older Adults Correct Semantic Memory Errors Better Than Younger Adults.**

JANET METCALFE, DAVID FRIEDMAN, *Columbia University*. Although older adults rarely outperform young adults on learning tasks, in this study they surpassed their younger counterparts not only by answering more semantic-memory general-information questions correctly but also by better correcting their mistakes. Older and younger adults answered a series of general information questions, followed by corrective feedback, while their event related brain potentials (erps) were monitored. At the end of the experiment they were retested on all questions on which they had given erroneous responses initially. While both young and older adults exhibited a *hypercorrection effect*, correcting their high-confidence errors more than their low-confidence errors, the effect was larger for young adults. However the reasons for the smaller hypercorrection effect shown by the older adults was that they also corrected their low confidence errors with a high probability, whereas younger adults tended to correct low confidence errors less. We investigated the patterns of event related potentials associated with the processing of the corrective feedback to the errors. While young adults evidenced an attentionally related p3a to high confidence errors but not to low confidence errors, older adults showed a p3a to both high and to low confidence errors. We argue that older adults are highly motivated by to learn the truth, and will invest their attention and effort to doing so for all errors that they commit.

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### **Object Location Long-Term Memory in Normal Aging.**

ANAT MANDELBAUM, HAGIT MAGEN, *The Hebrew University, Jerusalem, Israel*. Normal aging is accompanied by a gradual decline in spatial long-term memory which is essential in numerous everyday tasks such as navigation and locating objects in the environment. The present study investigated age-related decline in spatial long-term memory using an ecological object location memory task in which participants memorized the locations of objects embedded in pictures of indoor scenes. Locations were either generated by the computer or self-generated by the participants (with or without verbal elaboration). Following encoding, participants were tested in two different time points, after 30 minutes and after approximately one month. Memory performance was compared between two groups of 24 young and 24 old adults (age > 65). The results showed that the young adults' performance was better overall. Furthermore, while both young and older adults showed superior memory performance for self-generated locations compared to computer generated locations, the

advantage for self-generated locations was more substantial in the older adults group. At the one month follow-up, older adults showed better than chance memory performance for the self-generated but not for the computer generated locations. Taken together, the results suggest that age-related decline in spatial long-term memory is present but is less severe when tested in a more ecological memory tasks.

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### **Impaired Interference Detection in the Elderly Is Traced By Medial Frontal Theta Oscillations.**

CATARINA S. FERREIRA, *University of Granada and University of Birmingham*, MARIA JESÚS MARAVER, *University of Granada*, SIMON HANSLMAYR, *University of Birmingham*, MARIA TERESA BAJO, *University of Granada*.

The seemingly effortless task of recognizing other people's faces and retrieving their names seems to grow harder as people get older. Underlying these naming difficulties, a common complaint made by elderly people, could be the concurrent activation of related competitors. To investigate this hypothesis, we used the Retrieval Practice (RP) paradigm, shown to elicit interference between stimuli, while recording electrophysiological activity from a group of young and older adults. In the first study, after being exposed to a set of famous people's faces and names, participants performed three retrieval cycles on some of these names. In the second study, meant to rule out possible contextual deficit explanations, participants performed the same tasks, using semantic material. Both studies ended with a surprise memory test. Behaviourally, young participants showed a typical Retrieval Induced Forgetting (RIF) effect, whereas older did not. At a neural level, young adults (vs. older) showed an increase in theta power (~4-8Hz) upon presentation of a category cue. Moreover, young participants were capable of significantly reducing theta power across retrieval cycles, whereas no such reduction was found for the elderly. Thus, young adults seem to be more capable of detecting interference than older ones, as traced by medial-prefrontal theta oscillations. This more efficient detection of interference leads younger adults to recruit inhibitory mechanisms used to overcome competition, as reflected by a relative theta power decrease across retrieval cycles and by the behavioural RIF effect. The deficient interference detection by the elderly, however, renders them unable to recruit memory selection mechanisms, therefore eliminating RIF.

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### **Prospective Memory Impairment in Early Alzheimer's disease: A Virtual Reality Study.**

VALENTINA LA CORTE, VALENTINA FACQUE, MARIA ABRAM, *Institute of Psychology, University Paris Descartes, Sorbonne Paris Cite, INSERM UMR 894, Center of Psychiatry and Neurosciences, Memory and Cognition Laboratory*, PASCALE PIOLINO, *Institute of Psychology, University Paris Descartes, Sorbonne Paris Cite, INSERM UMR 894, Center of Psychiatry and Neurosciences, Memory and Cognition Laboratory, University Institute of France*.

Prospective memory (PM) is the ability to form, maintain and execute intended actions after a delay, in the appropriate context in the future. The realization of intentions consists in remembering that something has to be done in the future, remembering the exact action to be executed (retrospective component) and the context in

which it has to be done (prospective component). According to the context of the intention retrieval, three different types of PM have been defined: time-based (TB), event-based (EB), and activity-based (AB) actions.

The aim of this study was to investigate the cognitive mechanisms underlying PM deficits in healthy elderly subjects and in Alzheimer's disease (AD) patients using a naturalistic environment crated with virtual reality.

Participants walked in a virtual town comprising general urban elements such as building, traffic lights, pedestrians etc...and then they performed a retrospective (RT) and a prospective memory tasks.

Preliminary results show that AD patients are impaired in both tasks. Nevertheless they are more impaired in the RT compared to the PT. Within the PT they were deeply impaired in time-based tasks compared to event-based tasks. Furthermore congruent links between cues and actions facilitate execution of intentions in event-based tasks.

These finding suggest that virtual environments entail considerable potential for the assessment of PM in neurodegenerative diseases and they pave the way to future applications in cognitive rehabilitation programs focused on PM.

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Mild Cognitive Impairment (MCI) is a transitional state between normal ageing and dementia. In two studies, we focused on clarifying which specific type of memory processing was particularly disrupted in MCI, and so could serve as an early marker of cognitive decline. We wanted to verify and extend a novel, counterintuitive finding by McDaniel et al. (2011) that MCI primarily penalized automatic memory processes.

Study1 used the prospective memory paradigm (PM) in which participants had to remember to perform intended action when the target event appeared. We compared PM in 44 MCI individuals and 44 healthy older adults across target event focality. As predicted, the PM decline in MCI was more pronounced for focal tasks that were based on automatic retrieval than for non-focal tasks requiring strategic retrieval. Study 2 investigated, for the first time, whether MCI individuals differed from healthy older adults on the frequency of involuntary autobiographical memories that were automatically recalled during a monotonous laboratory task. Among all spontaneous thoughts recorded by 22 MCI individuals and 22 healthy older adults, it was only involuntary memories that were experienced less often by the MCI group.

Both studies consistently demonstrated substantial deficits in automatic processing in MCI. Implications of the results for explaining the nature of cognitive deficits in old age will be discussed.

## ALBENIZ ROOM, SATURDAY 7TH MAY, 17:20-19:00 TS33 Decision Making I

### Post-Decision Mechanisms: The Commitment Effect.

MARIUS USHER, ZOHAR Z. BRONFMAN, NOAM BREZIS, *Tel-Aviv University*, ANNE URAI, TOBIAS DONNER, *University Medical Center Hamburg*.

Behavioral studies over half a century indicate that making categorical choices alters beliefs about the state of the world. People seem biased to confirm previous choices, and to suppress contradicting information. These choice-dependent biases imply a fundamental bound of human rationality. Building on the framework of sequential-sampling models of decision-making, we developed novel psychophysical protocols that enable us to dissect quantitatively how choices affect the way decision-makers accumulate additional noisy evidence. In our experiments observers are presented with a controlled flow of evidence (RSVP numerical sequences, moving dot displays, or animations of fights between two opponents), and after a preliminary decision, they are provided, in some trials, with extra evidence and asked to evaluate their chosen alternative. We find robust choice-induced biases, such as a reduction in the sensitivity to the extra-evidence and reduction of the likelihood to revise decisions. Computational modeling reveals that choices trigger either a global gain reduction or a selective gain reduction of the evidence inconsistent with the preliminary decision, rather than a shifting of the decision variable towards the chosen alternative. These results are confirmed via the eyetracking of the pupils' dilations during the task and they show that categorical choices alter the evidence accumulation mechanism itself, rather than just its outcome, rendering the decision-maker less sensitive to new information.

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### Selective Integration: When Violations of Rational Choice Theory Are Adaptive.

KONSTANTINOS TSETOS, *Birkbeck, University of London*, NICK CHATER, *Warwick Business School*, RANI MORAN, MARIUS USHER, *Tel Aviv University*, CHRISTOPHER SUMMERFIELD, *Oxford University*.

Humans systematically violate rational choice theory but why the do so remains unclear. According to one mechanistic model (i.e. selective integration) violations of rationality, such as intransitivity and irregularity, stem from pre-integration input competition (i.e. selective gating) that reduces the gain of accumulation for alternatives that momentarily appear to be weaker. Interestingly, input competition nullifies late noise (arising beyond the sensory stage); and thus when late noise is present, selective integration outperforms the decision-theoretic optimal strategy. We hypothesized that if violations of rational choice are adaptive individuals with higher late noise will be more likely to employ stronger selective gating. Seventy-two participants had to choose the "overall highest" between two alternatives, each characterized by 9 sequentially occurring bars of different height, presented in two simultaneous streams. Their choices, showing hallmark violations of rational choice (i.e. intransitivity), were fitted to the selective integration model. As hypothesized, we report that selective gating correlated strongly with late noise. These results call into question



the long-standing argument that humans violate rational choice theory because they lack computational resources to engage in effortful executive processes. We suggest instead that apparently irrational choices arise from a mechanism that guarantees high decision accuracy when information processing takes place in a hierarchy of cortical layers, each one subject to independent noise.

### Alpha Oscillations Predict Task-Unrelated Thoughts and Reductions in Processing Efficiency.

GUY E. HAWKINS, *University of Amsterdam*, MATTHIAS MITTNER, *University of Tromsø*, WOUTER BOEKEL, *University of Amsterdam*, ANDREW HEATHCOTE, *University of Tasmania*, BIRTE U. FORSTMANN, *University of Amsterdam*.

Mind wandering, which involves temporarily losing track of time, place, or current task goals, frequently occurs during everyday tasks. In the laboratory, such task-unrelated thoughts are associated with impaired performance on behavioral variables, such as decreased accuracy and slower response times, and alterations in neural activity. We aimed to link these changes in outcome variables to mind wandering in a model-based neuroscience framework. Specifically, mind wandering was conceived as a neural state that affects the parameters of a cognitive process model, which in turn affects behavioral performance. Twenty-three participants each completed a task involving 700 simple perceptual decisions where mind wandering was monitored with thought sampling methods and neural activity was measured with electroencephalography (EEG). A time-frequency analysis of EEG activity in the pre-stimulus period was used to segment trials into cells consisting of lower- and higher-alpha power. Behavioral data from the low- and high-alpha power cells were fitted with a sequential sampling model of decision-making. Increased power of alpha oscillations in the pre-stimulus period was related to increased frequency of mind wandering and reductions in the efficiency of information processing in ongoing task performance. We conclude that trial-by-trial variability in neural oscillations can be related to changes in the parameters of cognitive process models, suggesting that alpha band activity may have a causal role in mind wandering.

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### Systematic, Individual and Situational Biases in Timing Decisions.

DAVID REITTER, MOOJAN GHAFURIAN, JENS GROSSKLAGS, *The Pennsylvania State University*.

We study personal and general biases in timing decisions, which concern practically common continuous decisions about when to act when facing external uncertainty and dynamic risk. In a series of experiments using a two-player game called FlipIt, we studied the influence of individual difference variables of Risk Propensity (RP) and Need for Cognition (NfC) and of manipulations that induce impatience. Participants make several timing decisions per round, which aim to counteract the hidden actions made by an opponent. The opponent's actions become visible only after the participant's choices have been made. Earlier actions are riskier, but a rational time point, maximizing utility, can be defined. Two experiments were run with a total of 450 participants from a general population that were compensated to incentivize maximizing payoff. RP and NfC were obtained with standardized instruments. Participants with RP around the population average benefitted from higher NfC levels ( $p < 0.01$ ). We also found a general impatience

bias that advanced timing independent of RP. With increasing task experience, models of linear impatience become better predictors of timing bias than risk-dependent ones. In a further experiment with 422 participants, impatience was manipulated by showing slow or fast-changing countdowns during a constant delay period. Timing (vs. rational strategy) was retarded or advanced, with fast countdowns reducing impatience ( $p < 0.01$ ) and accelerating countdowns yielding closer-to-rational performance even than the control (no delay at all). We conclude that timing decisions are affected by interacting risk and deep-processing preferences as well as situational impatience biases.

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### Ten Years of the Description-Experience Gap in the Sampling Paradigm: A Meta-Analytic Review.

DIRK U. WULFF, *Max Planck Institute for Human Development & University of Basel*, MAX MERGENTHALER, RALPH HERTWIG, *Max Planck Institute for Human Development*.

Life rarely affords us with perfect knowledge about the consequences of our choices. Yet, investigations into risky choice commonly assume that decision makers are equipped with such knowledge. A decade ago two influential studies demonstrated the limits of this practice. They pitted the fruit fly of behavioural decision science, the choice between fully-described monetary lotteries, against novel, experiential paradigms, in which the same lotteries had to be inferred from the experience of limited samples. They found that compared to decisions from description many classic decision phenomena, including the Allais Paradox and the fourfold pattern of risk preferences, were reversed in decisions from experience. In this meta-analytic review we reevaluate the predominant explanations of this gap between description and experience in a database consisting of the combined published data on the sampling paradigm of decisions from experience ( $>3000$  participants and  $>20000$  choices). Our analyses revealed that the gap persisted when sampling error arising from limited experiences is properly controlled for. In addition, we found that samples collected later in time were more correlated to choice than earlier ones. Both findings refute the still popular position that description-experience gap is a result of sampling error alone. Existing models of risky choice based decisions from description do thus not (readily) apply to decisions from experience.

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ANDALUCIA I & II ROOM,  
SUNDAY 8TH MAY, 8:00-10:00  
**TS34 Language Processing IV**

### Do People "Hear" A Sarcastic Tone of Voice when Silently Reading Sarcastic Text?

ALBERT N. KATZ, KAREN HUSSEY, *University of Western Ontario*.

The received wisdom is that people can mentally invoke a sarcastic tone of voice during silent reading though there is no direct evidence for this claim, empirically demonstrated here in two studies. In Study 1, participants ( $N=48$ ) silently read a set of ambiguous phrases as either being sarcastic or sincere, and chose from a set of adjective those that best describe the tone of voice that was invoked.



Sarcasm-discriminating and sincere-discriminating adjectives were identified. In study 2, a different sample (N=45) read a set of phrases in a minimal discourse context. The critical phrase (e.g., “isn’t she friendly”) was preceded by one of three contexts: positive (to invite a sincere reading), negative (to invite a sarcastic reading) and an ambiguous context that could invoke either a sincere or sarcastic reading. Following each scenario participants were asked to rate a set of adjectives as to the extent the adjective was mentally heard during silent reading: the adjectives were a subset of those that were sarcasm-discriminating, sincere-discriminating (as determined in Study 1) or a set of adjectives irrelevant to tone of voice. As predicted, even when not instructed to think sarcastically, participants rated most highly those adjectives chosen as associated with a sarcastic tone of voice in the negative context and least in the positive context.

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### Anticipation in Language Comprehension: Word Probability and Associability are Distinct in Brain Activity.

STEFAN FRANK, ROEL WILLEMS, *Radboud University*.

We recently showed that word-by-word brain activity during comprehension of naturally occurring texts is predicted by the words’ occurrence probabilities, as estimated by a computational language model. Encountering a less probable word increases N400 size and activity in the temporal lobes and visual word-form area (VWFA). This suggests that words are anticipated based on their probability. However, a second potential pathway to word anticipation is via priming by previously encountered associated words. Whereas word probabilities follow from a model that captures the languages’ structure (i.e., top-down), word priming can be viewed as bottom-up activation spreading in an associative/semantic network. Hence, the two pathways are conceptually distinct. But are they also neurally and cognitively distinct?

We reanalyzed the above-mentioned fMRI and EEG data, regressing brain activity at each content word on the word’s probability and on its associability with preceding content words. The latter was quantified as the distance between a distributed vector representation of the word and those of preceding words. Probability estimates and vector representations were extracted from a very large text corpus using standard Natural Language Processing tools.

Word probability and associability both predicted anterior temporal lobe activation, albeit in slightly different areas. Only probability was related to VWFA activation, whereas only associability predicted activation in areas related to semantics, such as the angular gyrus. This shows that the two measures are neurally (and, therefore, most likely also cognitively) distinct. Probability and associability displayed identical effects on the N400 ERP wave, suggesting that they affect language comprehension simultaneously.

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### Learning to Discriminate Synonymous Verbs in Russian: Do We Need Explicit Morphological Markers?

PETAR MILIN, *Eberhard Karls University Tübingen and University of Novi Sad*, DAGMAR DIVJAK, *The University of Sheffield*, R. HARALD BAAYEN, *Eberhard Karls University Tübingen and University of Alberta*.

We report on the computational modeling of data from a self-paced sentence reading task involving the manipulation of near-synonyms of the verb TRY in Russian. Speakers of Russian are sensitive to tense, aspect and mood (TAM) differences between the TRY verbs, as witnessed by shorter reading latencies on verbs with typical TAM markers. We modeled the SPR data computationally using the Naive Discriminative Learner (NDL). NDL was trained on two types of data: 1) on 1351 sentences from Russian corpora, manually annotated for a total of 14 multi-level morphological, semantic and syntactic properties, including TAM, and totaling 87 distinct contextual properties; 2) on three-letter sequences (trigrams), as appearing in utterances in a 90 million word corpus of Russian movie subtitles (Tiedemann 2012). We compared two types of models built with Generalized Additive Mixed Modeling (GAMM). The first model relied on NDL activations from the annotated corpus, thus utilizing morphological, semantic and syntactic information; the second model used trigram-based NDL activations only. The second model outperformed the first, as indicated by significant differences in fREML scores, given the degrees of freedom ( $\chi^2 = 16.078$ ;  $df = 1$ ;  $p < 0.001$ ). Further analysis of the strongest and weakest cues in the trigram-based model reveals that the strongest cues capture tense and mood, but not aspect. In doing so, they cut across traditional morphological lines. This undermines the dominant psycholinguistic assumption that morphological effects necessitate morphological representations: the effects of TAM marking are better accounted for without explicit representation of TAM morphology.

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### Dynamics of Brain Functions and Reading in Different Languages: Why Is It Hard To Read Arabic?

ZOHAR EVIATAR, *University of Haifa*.

Although Arabic is the 4<sup>th</sup> most spoken language in the world, and is one of the most popular segmental scripts used to write other languages, the study of reading in Arabic has only lately become a focus of research. I show data revealing that reading acquisition by children is slower than in a typologically similar language, Hebrew, and that skilled reading in Arabic is slower than skilled reading in Hebrew by university undergraduates. I present two possible sources for these phenomena from both a psycholinguistic and a neuropsychological perspective. The first is the diglossia in Arab society, where the language that is written and read is different from the language that is spoken. I show that this difference is great enough to result in bilingual-like performance among Arabic-speaking children, and that it affects the course of reading acquisition. The second source of difficulty is the visual characteristics of the Arabic writing system, which together with the complex relationship between graphemes and phonemes, affects the involvement of the right hemisphere in letter and word identification, and in the access to meaning. This is supported by patterns from divided visual field paradigms. I present the case of reading in Arabic as an example of the interaction of brain functions, language structure, and the language experience of the individual, outlining the seam between universal and specific attributes of the reading process.





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### Electrophysiological Correlates of Semantic Anticipation during Speech Comprehension.

JOAQUÍN MORÍS, *University of Oviedo*, PATRICIA LEÓN CABRERA, ANTONI RODRÍGUEZ-FORNELLS, *University of Barcelona*.

Words that are more predictable given a previous context show facilitated processing over low predictable ones. Such facilitation has been traditionally viewed as associated with reduced amplitudes in the N400 component. However, this facilitation effect could be due to words being predicted or because they are easier to integrate with their context upon receipt. A way to understand the contribution of each of these processes is to test the possible existence of neural correlates of anticipation prior to target words. We did so by inserting a 1000 ms delay between the penultimate and the final word of sentences of different semantic constraining levels, and measuring the event related potentials generated during that period. In addition, half of the final words were congruent with the context while the other half were incongruent. A slow potential with a frontal distribution developed during the delay interval, beginning 200 ms after the start of the delay and increasing progressively until the presentation of the final word. The amplitude of the slow potential varied as a function of contextual constraint, larger for low than high contextual constraint, suggesting that it indexed anticipatory processes. Contrarily, amplitude variations of N400 component elicited by final words were not consistent with an interpretation of the N400 based exclusively on predictive processes. The present results support theories of semantic anticipation but they require of additional processes to be adequately explained.

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### The Paca That Roared: Cumulative Semantic Interference Reveals Immediate Semantic Integration of Newly Acquired Vocabulary.

GARY M. OPPENHEIM, *Bangor University/Rice University*.

Recent evidence suggests that speakers are constantly re-optimizing their vocabularies, prioritizing access to the words they've found most useful in the recent past. Naming a picture of a badger, for instance, persistently facilitates later access to 'badger' but also persistently impairs access to 'hedgehog' (cumulative semantic interference). But what happens when acquiring a new mammal word, like 'paca'? Would it immediately engage in this re-optimization process, or would it require consolidation before such competitive effects emerged? Over the course of a 30-minute training procedure, I introduced 18 participants to three novel and three familiar exemplars of each of six semantic categories (all concrete nouns, e.g. MAMMALS: paca, yapok, fossa, badger, hedgehog, tiger), and had them rate their pre-exposure familiarity with each, to focus later analyses on confirmed-novel and confirmed-familiar exemplars. Without delay, participants then named each of the color photographs six times, in six sequentially counterbalanced multi-category 36-item cycles. Maximal linear mixed effects regressions of inverse-transformed single-trial correct-name RTs revealed significant cumulative semantic interference throughout each category (from familiar to familiar, familiar to novel, novel to familiar, and novel to novel). Re-testing participants 2-6 days later generated similar-magnitude estimates for all interference effects, suggesting that while sleep-based consolidation may generally

hasten the retrieval of newly acquired words, it is not a necessary precondition for the their semantic integration.

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### ANDALUCIA III ROOM, SUNDAY 8TH MAY, 8:20-10:00 TS35 Categorization

#### The Inferential Value of Coherence in Causal-Based Categorization.

SERGIO E. CHAIGNEAU, ENRIQUE C. CANESSA, *Adolfo Ibáñez University*.

Causal knowledge has well-documented impacts on categorization. Two relevant mechanisms are inference and coherence. Inference affects categorization because causal knowledge allows inferring the state of unknown properties (e.g., knowing that  $A \rightarrow B$  allows using A to infer the state of B). If the unknown property is diagnostic for classification, then the property used for making the inference will increase its value for categorization. Coherence affects categorization because people judge that exhibiting the pattern of properties expected due to the category's known causal relations is evidence of category membership (e.g., if in the category  $A \rightarrow B$ , then a category exemplar should show A and B). Previous work in our laboratory suggests that coherence may also play an inferential role in categorization, informing about the state of unobserved diagnostic properties. The work we report tested this hypothesis. Participants learned about a novel category with 4 properties. These properties could be causally related (causal condition) or not (not-causal condition). Participants in the causal condition were trained in a causal chain model with 3 properties ( $A \rightarrow B \rightarrow C$ ), plus a fourth unrelated property (D), and were told that the last property in the chain (C) was diagnostic for classification. After training, participants classified exemplars under two conditions: with or without information about property C. As expected, when information about property C was not provided, participants needed to infer it, and coherence effects increased. Further research is needed to test if these results extend to other causal models (e.g., common cause, common effect) and to different materials.

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#### Learning about Features or Relations (But Not Both): A Laboratory Analogue of the Inert Knowledge Problem.

EVAN LIVESEY, HILARY DON, MICAH GOLDWATER, *University of Sydney*.

Transfer of knowledge to novel contexts is the mark of successful learning. However, 100 years of education research has shown that transfer from learning examples to novel examples of an abstract category (e.g., problems that concern Newton's laws of motion) is extremely challenging. Students naturally vary in their propensity to transfer, and this relates to their learning strategy. That is, some students start with the strategy to look for generalizations across learning examples via an abstract rule, while other students look to memorize instances, which promotes focus on the superficial. To study these dynamics in the laboratory, we have developed a classification task that can be solved reasonably well by learning the surface features of category members, but can also be solved

perfectly by applying a relational rule that requires comparison across the stimulus features. In a series of studies we have examined 1) how participants generalise to new instances of the same categories in which the relational rule and features are differentially informative, and 2) how participants transfer their knowledge to a new task in which a similar abstract rule applies but the surface features are very different. Although university students were more likely to show a tendency to learn about the superficial features of the stimuli, learning of the relational rule was sensitive to manipulations of learning conditions that differentially emphasise the superficial features or underlying rule. Participants also showed a striking inability to learn about both the relational rule and the surface features of the task.

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### Hypothesis Generation Sets the Stage for Self-Directed Category Learning.

DOUG MARKANT, *Max Planck Institute for Human Development*. Although many educators embrace *self-directed learning* in which students control the information they experience, it remains unclear how the efficacy of this approach depends on the material to be learned. A recent examination of self-directed category learning suggests it may be of limited value depending on the form of the target concept: whereas self-directed selection of training items led to faster learning of one-dimensional (1D) classification rules compared to passive reception of randomly generated items, no such benefit was found for two-dimensional (2D) rules. The present study examined whether this differential impact of self-directed selection is based on the ability to generate hypotheses of the same form as the target rule. I predicted that people generate 1D hypotheses when feature dimensions are highly separable (*absolute* features defined on different scales), but are more likely to generate 2D hypotheses when features are easily comparable (*relative* features defined on the same scale). The results of two experiments showed that successful learning of both types of rules depended on whether the feature representation led to the generation of hypotheses of the same form (confirmed by modeling of classification boundaries at test). In contrast to previous research suggesting that 2D rule learning is slower and governed by a different process than 1D rules, these findings demonstrate that people can quickly learn both types of rules through self-directed selection, but that its success depends on a latent process of sequential hypothesis generation that is influenced by a variety of stimulus properties.

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### Hemispheric Contributions during Categorisation of Natural Images.

SARA SPOTORNO, *University of Aberdeen*, ANAIS LEROY, SYLVANE FAURE, *University of Nice Sophia Antipolis*.

The semantic relationship between scene context (background, global level) and foreground objects (local level) is crucial for our ability of interpreting the visual world from a brief glance. Previous research has suggested that these levels mutually interact during fast context and object categorisation, with better performance when they are semantically consistent. We examined the contributions of the cerebral hemispheres to context-object semantic processing, using divided-visual-field rapid (130 ms) presentations. Experiment 1 analysed the influence of the right hemisphere and left hemisphere specialisation for global vs. local perception, respectively, and

investigated whether a hemispheric asymmetry in the processing of semantic consistency emerges. In each trial, a scene with a context and an embedded object was presented in the left (lvf) or right visual field (rvf). The results showed better context than object categorisation, and an advantage for both categorisations in case of consistency. We found no differences between visual fields, suggesting that categorisation is not influenced by hemispheric specialisation. Experiment 2 examined the role of interhemispheric interaction, presenting the context and the object, pasted on 1/f coloured background noise, one in the lvf and the other in the rvf. While performance was comparable between context and object categorisations, we replicated the effect of semantic consistency on both categorisation levels. This indicates that semantic memory for scene context-object associations is activated even when the object is not included in the scene. It also suggests that the hemispheres early share global and local information in order to represent the whole scene semantic configuration. Email: Sara Spotorno, [sara.spotorno@abdn.ac.uk](mailto:sara.spotorno@abdn.ac.uk).

MACHADO ROOM,  
SUNDAY 8TH MAY, 8:20-10:00  
TS36 Testing

### Optimizing Schedules of Retrieval Practice: Successive Relearning Overrides Initial Lag Effects.

KATHERINE A. RAWSON, *Kent State University*, KALIF E. VAUGHN, *Williams College*, MATTHEW WALSH, *Carnegie Mellon University*, JOHN DUNLOSKY, *Kent State University*.

The benefits of retrieval practice for long-term retention are greater with longer versus shorter lags between practice trials. However, learning to criterion takes longer with longer versus shorter practice lags. Do these effects of initially learning with longer versus shorter lags persist if students subsequently engage in relearning? In two experiments, participants initially learned Lithuanian-English word pairs to criterion (i.e., retrieval practice until items are correctly recalled) with longer or shorter lags between trials. The number of trials needed to reach criterion was greater with longer versus shorter lags (i.e., greater cost of initial longer lag), but retention test performance several days later was greater with longer versus shorter lags (i.e., greater benefit of initial longer lag). Importantly, participants subsequently completed relearning sessions separated by several days, in which all items were relearned to criterion at a fixed long lag. Fewer trials were needed to relearn items that were initially learned with a longer versus shorter lag, but the increased relearning efficiency did not always offset the inefficiency of initial learning (i.e., persistent cost of initial longer lag). In contrast, subsequent relearning substantially attenuated the benefit of initially learning items with a longer versus shorter lag (i.e., relearning overrides the benefit of initial longer lag). The overall pattern of performance within and across sessions was well fit by an ACT-R model assuming that rate of forgetting following a given practice trial is a function of current activation level.

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### Testing an Attentional Account of Test Potentiated Learning.

TIMOTHY J. HOLLINS, CHRISTOPHER MITCHELL, *Plymouth University*.

Learning the meaning of an unfamiliar foreign word is boosted by making an incorrect guess before seeing the correct answer, relative to an equivalent period spent studying the unfamiliar item and its meaning presented together. The mechanism for this test-potentiated-learning (TPL) effect is not agreed upon, but one possibility is that guessing engenders greater attention to the cue word when it is initially presented. Two experiments tested this basic idea in two ways: 1) by examining whether TPL is specific to guessing the meaning of the target, or if it occurs following generation of any associate to the cue, 2) the extent to which the effects of generation boost memory independently for the cue and the target in the pair. Participants attempted to learn Finnish-English translation pairs, either by study alone, by guessing the meaning followed by the answer, or by generating the first associate of the cue they thought of followed by the answer. Experiment 1 demonstrated that both guessing the meaning, and generating an associate equally boosted recognition of the cue and target words, relative to study alone, suggesting that increased attention to the cue or target could underlie TPL. However, Experiment 2 used a cued-recall test and showed that, relative to study alone, guessing a meaning boosted performance, but generating an associate impaired performance. These data rule out a simple attentional account of the test-potentiated learning effect.

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### The Two Processes underlying the Test Effect ---Evidence from Event-Related Potentials (ERPs).

XIAONAN LIU, *Xiamen University; Carnegie Mellon University*, DEBORAH TAN, *Carnegie Mellon University*, YA ZHANG, *University of Pittsburgh*, LYNNE REDER, *Carnegie Mellon University*.

Theoretical explanations of the testing effect have focused on either a retrieval process or a re-encoding process after retrieval. Based on prior neuroimaging evidence, we propose that both processes contribute to the benefits of testing. To test this account, we recorded ERPs while subjects studied, re-studied or took cued-recall tests of word pairs. ERPs were analyzed based on current and subsequent test accuracy, yielding three conditions: both tests correct, both in correct and correct followed by incorrect. The mean amplitudes of waveforms between 400-700 ms during the first test were highest when both tests were correct and lowest when both were incorrect while the mean amplitudes between 700-1000 ms only differed as a function of subsequent memory, higher when the later test was correct. We interpreted the earlier time window as a component reflecting a retrieval process and the later time window as a component reflecting a re-encoding process.

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### There Are Limits to the Effects of Task Instructions: Making the Automatic Effects of Task Instructions Context-Specific Takes Practice.

SENNE BRAEM, BAPTIST LIEFOOGHE, JAN DE HOUWER, MARCEL BRASS, ELGER ABRHAMSE, *Ghent University*.

Unlike other animals, humans have the unique ability to share and use verbal instructions to prepare for upcoming tasks. Recent

research showed that instructions are sufficient for the automatic, reflex-like activation of responses. However, systematic studies into the limits of these automatic effects of task instructions remain relatively scarce. In this study, we set out to investigate whether instruction-based automatic activation of responses can be context-dependent. Specifically, participants performed a task of which the stimulus-response rules and context (location on the screen) could either coincide or not with those of an instructed to-be-performed task (whose instructions changed every run). In two experiments, we showed that the instructed task rules had an automatic impact on performance – performance was slowed down when the merely instructed task rules did not coincide, but, importantly, this effect was not context-dependent. Interestingly, a third and fourth experiment suggests that context dependency can actually be observed, but only when practicing the task in its appropriate context for over sixty trials or after a sufficient amount of practice on a fixed context (the context was the same for all instructed tasks). Together, these findings seem to suggest that instructions can establish stimulus-response representations that have a reflexive impact on behavior, but are insensitive to the context in which the task is known to be valid. Instead, context-specific task representations seem to require practice.

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### The Experience of Repeated Testing Influences the Subsequent Encoding of Social Categories.

TOMÁS PALMA, LEONEL GARCIA-MARQUES, PEDRO MARQUES, *University of Lisbon*.

Social categorization has been portrayed in the literature as an automatic and uncontrollable process that carries important consequences for person perception. Such strong conclusions were, however, drawn from studies using single test phases in which participants are typically confronted with unfamiliar tasks whose requirements are unpredictable to them. In contrast, we propose that social categorization is action oriented, that is, the encoding and storage of social categorical information in memory is shaped by the requirements of the surrounding context. This hypothesis is based on recent findings showing that the experience of being repeatedly tested serves as a powerful cue for the most effective ways to encode similar information in the future. We tested our hypothesis in two experiments with four study-test cycles. In the study phases, participants saw pairs of face-statement. In the test phases only the statements were presented. In the first three tests, participants were asked to retrieve either the gender or the age of the faces previously paired with the target sentences. Critically, in the fourth test, they had to retrieve both gender and age. Results showed that performance (i.e., time and number of correct responses) improved along the three first tests and dropped substantially in the last test, when the social category that had been irrelevant so far had to be retrieved. These results suggest that participants were capable of optimizing their encoding strategies as a function of previous retrieval experiences. Our research highlights the relevance of using multiple study-test cycles when researching social categorization processes.

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PICASSO ROOM,  
SUNDAY 8TH MAY, 8:00-10:00  
TS37 Cognitive Aging II

**Fluid and Crystallized Discrepancy in Healthy Adults: The Relationship with Beta-Amyloid and Cortical Thickness.**

IAN M. MCDONOUGH, *The University of Alabama*, GÉRARD N. BISCHOF, *University Hospital Cologne/Institute of Neuroscience & Medicine Research Centre*, KRISTEN M. KENNEDY, KAREN M. RODRIGUE, MICHELLE E. FARRELL, DENISE C. PARK, *University of Texas at Dallas*.

Measures of basic cognitive processes (fluid abilities) are highly correlated with measures of knowledge (crystallized abilities) in healthy adults. Fluid abilities, however, decline more rapidly than crystallized abilities in early stages of Alzheimer's disease (AD). We hypothesized that cognitively-normal older adults who evidenced lower fluid ability compared to crystallized ability (a discrepancy) would show evidence of early AD neuropathology indexed via *in vivo* measures of cortical thickness and beta-amyloid (A $\beta$ ) deposition in regions vulnerable to AD. A sample of older adults ( $n = 112$ ) aged 65 to 89 underwent a cognitive battery, structural MRI, and a subset ( $n = 75$ ) also underwent PET imaging. Of this sample, 60 older adults evidenced an ability discrepancy where fluid ability was lower than crystallized ability. As predicted, the magnitude of the ability discrepancy was independently associated with thinner cortex, a higher burden of A $\beta$ , and greater chronological age. Thus, a substantial ability discrepancy in old age appears to be a behavioral marker of neuropathology consistent with biomarkers that are suggestive of preclinical dementia.

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**Cognitive Change Across the Lifespan: Four-Year Longitudinal Findings in the Dallas Lifespan Brain Study (DLBS).**

XI CHEN, SARA B. FESTINI, *University of Texas at Dallas*, IAN M. MCDONOUGH, *The University of Alabama*, DENISE C. PARK, *University of Texas at Dallas*.

Although age-related declines in cognition have been consistently found in cross-sectional studies, there are discrepant age trends in longitudinal and cross-sectional analyses. Cross-sectional studies are more vulnerable to cohort effects, whereas longitudinal studies are more vulnerable to test-retest effects. In the present study, we compared cross-sectional and longitudinal age effects in different cognitive domains across the entire adult lifespan. In a sample of 227 healthy individuals from the Dallas Lifespan Brain Study (DLBS), ranging in age from 20 to 89, we evaluated performance in processing speed, working memory, reasoning, episodic memory, and crystallized knowledge at two occasions with an average interval of 4 years between assessments. We found cross-sectional linear decreases associated with increasing age in processing speed, working memory, reasoning, and episodic memory, and an age-related linear increase in crystallized knowledge. For longitudinal change over 4 years, we found that, for processing speed, working memory, and reasoning, older adults tended to show longitudinal declines whereas younger and middle-age adults tended to show improvements or stability. Although, we note considerable inter-individual variability in 4-year longitudinal change across the

lifespan. Interestingly, different from the cross-sectional findings, longitudinal analyses indicated that crystallized knowledge remained stable up to age 70, with evidence for decline thereafter. Overall, the present results show that, although cross-sectional findings suggest more uniform declines in cognition across domains with age, our longitudinal data indicate steeper declines in processing speed, reasoning, and working memory in older adults, and that crystallized knowledge began showing longitudinal decline after age 70.

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**Persistent Face Bias in Older Adults Judging Trustworthiness.**

ATSUNOBU SUZUKI, *Nagoya University*.

**Objectives.** When judging someone's trustworthiness, facial appearance is a salient but non-diagnostic cue. This judgment should instead be based on an individual's past behavior. Independent lines of research indicate that aging impairs memory-based decision-making and increases use of diagnostic information for social inference, predicting an age-related decline and improvement in judging someone's trustworthiness, respectively. The present study tested these competing predictions. **Method.** Participants were 36 older adults (OA) and 36 younger adults (YA). They played an investment game, wherein they decided whether to deposit money in an investee, whose face was displayed on a computer monitor. There were two different traits of investees ("good" and "bad"), who respectively repaid and embezzled the deposit. The investee's face (trustworthy- and untrustworthy-looking) and trait (good and bad) were manipulated orthogonally. **Results and Discussion.** A memory test of the investee's trait revealed that after four rounds of the game, OA but not YA were still reluctant to make face-incongruent judgments (e.g., judgments of trustworthy-looking investees as bad). Persistent reliance on facial appearance for judging trustworthiness could increase the risk of repeat victimization of fraud in OA, since a potential fraudulent person could pretend to be trustworthy to induce another's trust.

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**Age Differences in Risk Taking.**

RUI MATA, *University of Basel*, ANIKA K. JOSEF, RALPH HERTWIG, *Max Planck Institute for Human Development*.

Past empirical work suggests that aging is associated with decreases in risk taking. But are such effects universal? Life history theory suggests that the link between age and risk taking is a function of specific reproductive strategies that can be more or less risky depending on the ecology. We assessed variation in the age-risk curve using World Values Survey data from 77 countries ( $N = 147,118$ ). The results suggest, first, that risk-taking propensity tends to decline across the life span in the vast majority of countries. Second, there is systematic variation between countries: Countries in which hardship is high (e.g., high infant mortality) are characterized by higher levels of risk taking and less steep age-risk curves. These findings suggest that hardship may function as a cue to guide life history strategies and that age-risk relations thus cannot be understood without reference to the demands and affordances of the environment. Finally, we discuss these results in light of those from meta-analyses of age differences on behavioural measures of risk taking (Best & Charness, 2015; Mata, Josef, Samanez-Larkin, & Hertwig, 2011) and the resulting implications for understanding





the concept of risk-taking propensity.  
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### **Role of Prospective Memory and Aging in Medical Adherence: An Empirical Investigation.**

AZIZUDDIN KHAN, *Indian Institute of Technology Bombay.*

Prospective memory involves forming an intention and then realizing it at some appropriate time or in response to some external cue in the future (Harris, 1984). Researchers have distinguished two kinds of prospective memory: event-based and time-based. Medical adherence is the ability of a person to take medicine as prescribed by the doctor at the appropriate time and in appropriate amount. The ability to take medicines may depend on the ability to prospectively remember to do the tasks.

An experimental study was conducted on 200 subjects to investigate the role of prospective memory and age in medical adherence. 49 participants belonged to the age group of 16-25, 46 belonged to the age group 26-40, 50 were in the age group 41-54 and 48 participants were in the age group 55 and above. Prospective memory was measured by CAMPROMPT and medical adherence was measured by Morisky's seven item medical adherence scale. Intelligence was also measured as a covariate for which Test of Non Verbal Intelligence-4 (TONI-4) was employed. A series of univariate analyses were carried out. Results showed a significant effect of age on medical adherence, higher the age better the level of adherence and age and time, event and total prospective memory. Pearson's *r* correlation was employed to see the relationship between prospective memory, age, time and event based prospective memory and medical adherence. Results also revealed positive correlation between prospective memory and age and medical adherence. The current study can be applied for increasing medical adherence.

Key Words: Covariate, Intention, Morisky, and TONI

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### **Age-Related Differences in Touch-Based Visual Search.**

SOWON HAHN, *Seoul National University.*

Age-related cognitive decline has been rigorously studied and is known to be especially evident in individuals in novel environments. The traditional view holds that older adults are not willing to adopt new technologies because such an interface can place them in new and unfamiliar environments. However, mobile personal computing that has reached a new level of human-computer interaction is ubiquitous in every aspect of life for all ages. To understand unique characteristics of touch-based human-computer interaction, we investigated the visual search performance of older and younger adults in a touch-based environment. Participants conducted a visual search task either by pressing a key on the keyboard or by touching the target on a touch-screen monitor. Though older adults were generally slower than younger adults, their performance was equally as effective when utilizing the touch response and key-press response. The most prominent difference was that older adults showed increasingly impaired performance as the stimulus display was rotated in their spatial orientation. The present results support the idea that touch-interface technology can be effectively utilized for both younger and older adults, but older adults are selectively impaired in the task requiring spatial rotation.

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MACHUCA ROOM,  
SUNDAY 8TH MAY, 8:00-10:00  
**TS38 Methodology**

### **Prevalence of Questionable Research Practices among Italian Psychologists.**

FRANCA AGNOLI, *University of Padova*, JELTE WICHERTS, COOSJE VELDKAMP, *Tilburg University*, PAOLO ALBIERO, *University of Padova*, ROBERTO CUBELLI, *University of Trento*. Questionable research practices (QRPs) increase the likelihood of finding evidence in support of a hypothesis, but the evidence may be spurious. John, Loewenstein, and Prelec (2012) surveyed academic psychologists at U.S. universities and found that a surprisingly large percentage had engaged in QRPs. We investigated the prevalence of these practices within the Italian psychological research community. We surveyed 277 members of the Association of Italian Psychologists (AIP) regarding their use of the same 10 QRPs studied by John et al. The results are strikingly similar to those obtained for U.S. psychologists, showing that QRPs are about equally widespread in both research communities. For example, more than 50% in both research communities reported that they had decided whether to collect more data after first checking whether the results were significant, whereas less than 3% in both communities reported that they had falsified data. In this talk, we will describe the ten QRPs studied and the frequency of their use within the Italian research community. The frequencies of use differed systematically across QRPs, and some respondents explained in a free-text section of the survey why they considered the use of more frequently adopted practices to be justifiable. These results confirm that extreme forms of scientific misconduct are rare, but a large percentage of psychologists employ questionable practices. Some researchers consider these practices justifiable in certain circumstances, despite the risk of finding spurious evidence in support of the research hypothesis.

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### **Multiple Comparisons and False Positive Rates in Eye Tracking Studies of Reading Behaviour.**

BERNHARD ANGELE, *Bournemouth University*, TITUS VON DER MALSBURG, *University of California San Diego*.

Standard analyses of eye movements in reading test a set of canonical dependent measures calculated for multiple regions. Although the resulting multiple comparisons increase the rate of false positive results, it is accepted standard practice not to correct for that. We investigated false positives rates through computer simulations and tested how much statistical power has to be sacrificed to control them. In 100,000 iterations, we generated six realistic data sets of eye movements for a hypothetical experiment with typical parameters. The true effect sizes of the hypothetical manipulation ranged from 0 ms to 40 ms. Four standard measures were analyzed using linear mixed models: first fixation duration, gaze duration, go-past time, and total viewing time. In the data sets with no true effect, the rate of false positives was 12.1%, i.e. much higher than the conventionally accepted 5%. A Bonferroni correction reduced false positives to 3.2% and was therefore slightly more conservative than required. The reduction in power due to the Bonferroni correction was moderate, e.g., from 90% to 75% for effect sizes of 5 ms. Thus,

contrary to conventional wisdom, the Bonferroni correction seems to be an appropriate tool for controlling false positives.

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### Improving the Interpretation of Confidence and Credible Intervals.

RINK HOEKSTRA, *University of Groningen*, RICHARD D. MOREY, *Cardiff University*, ERIC-JAN WAGENMAKERS, *University of Amsterdam*.

Confidence intervals (CIs) are often advocated as an alternative to or supplement for the frequently criticized significance test. It has been shown, however, that neither students nor researchers find them easy to interpret. The interpretation of CIs is difficult by nature; if they are to be standard tools, it is critical that potential users understand them. To understand why students and researchers misunderstand CIs, we undertook an analysis of introductory statistical textbooks, which show striking variability of interpretations of CIs and an alarming frequency of incorrect interpretations. Notably, quite a few textbooks authors themselves show uncomfortableness about the interpretations of CIs. To help remedy the confusion we present a freely available R-package in which the interpretation of both CIs trained and compared to that of Bayesian credible intervals. The software is informed by previous findings in the statistical cognition literature.

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### Cortical Waves Are Not Space-Time Separable: Evidence from Velocity Estimates in Large-Scale Cortex.

DAVID M. ALEXANDER, *KU Leuven*.

Scalp-recorded and intra-cranial cortical activity reveals globally coherent patterns of phase that are in motion. We show how these patterns are obscured by commonplace analysis techniques that aggregate brain activity measures across-trials, whether prior to source localization or for estimating intra-areal coherence. When analyzed at single-trial level, whole head MEG and EEG shows episodes of globally coherent activity in the delta, theta, alpha and beta bands of the signal in the form of large-scale waves, which propagate at various velocities. Their mean speed is estimated to be in the range 0.06 to 4.0 m/s, and is proportional to temporal frequency. These estimates take into account a range of wave behaviors, including traveling waves and standing waves. The location of the maxima and minima in field strength was found to move over the entire sensor array, during both ongoing activity and task-relevant intervals. This is evidence against understanding traveling wave observations as motion of localized dipoles, or as driven by connection delays from a common subcortical source. We argue that much of the cortical signal is not space-time separable, and that measures which assume space-time separability, such as ERPs, General linear modeling (GLM) to uncover "activation" in fMRI, and cross-trial coherence, throw out much of the relevant signal. Localized, interacting modules of activity cannot be assumed without first ruling out traveling waves at the individual trial level.

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### Cross-Frequency Coupling: How It Emerges, What It Means, and When It Occurs.

CHIE NAKATANI, *KU Leuven*.

Electrophysiological brain signals on the scale of EEG, MEG, and ECoG emerge as a result of activity in networks of neurons. Various types of neuronal and glial cells are involved in these networks, but for the sake of modeling the signal, the cell types could be restricted to four population categories: pyramidal neurons, excitatory interneurons, slow inhibitory interneurons, and fast inhibitory interneurons, by considering only the effect of activation (excitatory or inhibitory), dynamics (e.g., slow or fast response), and connection range (connections are made locally or long-range). Four-population models were found to be able to simulate various types of brain activity, e.g., alpha blocking, sleep spindle, and evoked responses. Given these successful simulations, four-population models have become the standard for modeling mesoscopic electrophysiological signals in cortex. Two four-population models that are mutually connected via long-range connection are a minimum model for activity coupling between cortical regions. We recently demonstrated that this connected 4-population model was capable of generating all known types of cross-frequency couplings, phase-amplitude, phase-frequency, amplitude-amplitude, amplitude-frequency, frequency-frequency coupling, and phase-phase coupling. I will discuss the implications of applying the model to cross-frequency coupling analyses of brain signals and how the results are to be interpreted.

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ALBENIZ ROOM,

SUNDAY 8TH MAY, 8:00-10:00

### TS39 Judgement and Reasoning

#### The Subjective Utilitarian Model of Moral Judgment.

DALE J. COHEN, *University of North Carolina Wilmington*, MINWOO AHN, *University of Southern California*.

Moral judgments lie at the heart of life's most difficult choices. Current theories hypothesize that moral judgments arise from competing decision processes: a rational, objectively utilitarian process vs. an intuitive/emotional process. Such theories state that the participant's response choice identifies the decision process that "wins" the conflict. We argue that moral judgments are inherently utilitarian, though subjective. In short, people try to save the competing item with the greatest "personal value." We term this *Subjective Utilitarianism*. Last year we demonstrated that the model accounts for over 90% of the variance in the RT and response choice in moral judgment scenarios. This year, we will review the model and present a series of experiments that test the model under a variety of experimental conditions. The data shows that the model is extremely robust, accounting for over 90% of the variance in RT and response choice when: participants are under time pressure, scenarios from Greene and colleagues are used, and when the presentation format of the scenario is altered. We conclude that the Subjective Utilitarian Model of Moral Judgment is a precise, parsimonious, and valid description of the cognitive processes involved in moral judgment.

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### How Positive Affect and Performance (Non-)Contingent Reward Modulate Cognitive Control.

KERSTIN FRÖBER, GESINE DREISBACH, *University of Regensburg*.

Reward is obviously associated with positive affect, which is why both terms have often been used interchangeable in the existing literature. Results from mostly independent research lines on motivational and emotional modulations of cognitive control, however, suggest a clear dissociation of reward (= motivation) and positive affect (= emotion) manipulations: reward usually increases proactive control, whereas positive affect is associated with reduced proactive and/or increased reactive control. But so far little research has been done to directly compare different reward and positive affect manipulations. Therefore we conducted two consecutive studies with integrative designs: In Study 1 we systematically manipulated positive affect, performance contingent and non-contingent reward within a single experiment ( $N = 80$ ). Study 2 was a follow-up study investigating how performance contingent and non-contingent reward modulated cognitive control as compared to a neutral control group without reward manipulation ( $N = 81$ ). Results confirmed a motivational effect of performance contingent reward in terms of increased proactive control. And we replicated the typical positive affect effect in terms of reduced proactive control. Moreover, our integrative approach resulted in several new findings: (1) Motivational influences outweigh affective influences. (2) Performance non-contingent reward does not result in the typical motivational effect but rather mirrors the influence of positive affect. (3) The oppositional effects of performance contingent and non-contingent reward cannot be explained by practice or time on task. In sum, both studies confirm the motivational vs. affective impact of performance contingent vs. non-contingent reward on cognitive control.

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### A Hard-to-Read Font Reduces the Causality Bias: The Role of Processing Fluency in Causal Illusions.

HELENA MATUTE, MARCOS DÍAZ-LAGO, *Deusto University*.

Previous studies have demonstrated that fluency affects judgment and processing style. The purpose of the present research was to investigate the effect of processing fluency in a causal learning task that usually induces an illusory perception of causality. We predicted that a reduction of processing fluency could improve accuracy in the detection of null contingency and, therefore, be a factor to debias illusory perceptions of causality. One hundred sixteen participants performed a standard contingency learning task. They were assigned to one of four experimental groups (non-contingent/easy-to-read, non-contingent/hard-to-read, contingent/easy-to-read, or contingent/hard-to-read). In the non-contingent conditions the outcome and its potential cause were independent events. Thus, any judgment about their causal relationship that differs significantly from zero can be taken as evidence of a cause-effect bias. Overall, the results showed statistical differences as a function of the font type in the judgments of causality for the non-contingent conditions. Specifically, a strong overestimation of causality was observed in those participants who performed the task in an easy-to-read font, whereas those in the hard-to-read condition judged the causal relationship more accurately. Overall, our results provide evidence of a reduction of the causality bias by presenting the problem in a hard-to-read font, suggesting that

processing fluency affects causal judgments. Email: Helena Matute, [matute@deusto.es](mailto:matute@deusto.es)

### Assessing Causal Biases in Children.

M. MANUELA MORENO-FERNÁNDEZ, FERNANDO BLANCO, HELENA MATUTE, *Universidad de Deusto*.

The ability to detect causal relations may be considered a basic tool for adapting to the environment. However, under specific circumstances, it can be easily biased leading to inaccurate conclusions about the causal connection between events. One factor that has shown to influence causal judgements is the base rate of the outcome: People tend to overestimate the strength of a causal relation when the consequence, or outcome, occurs with a high probability. This overestimation may occur even when there is no actual relation between the potential cause and the consequence, producing causal biases. The impact of these biases can range from innocuous superstitions to really dangerous behaviors that may even compromise our life. Childhood may be considered an optimal period for developing educational interventions aimed at reducing the negative impact of causal biases, but they have not been systematically evaluated at this stage of development, and specifically the outcome-probability bias described above still remains unexplored at this age.

The present experiment was conducted to assess outcome-probability biases in young children. We developed a new procedure based on the standard contingency judgment task in order to evaluate children's causal learning ability on a null contingency situation. Participants were exposed to two similar causal scenarios, differing only in the outcome's probability (high or low). Children's performance was influenced by the outcome's frequency, showing that young children develop an illusion of causality similar to that of adults. Implications for interventions at early stages of development are discussed.

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### The Challenges to Measuring the Multidimensional Construct "Risk Attitudes".

RENATO FREY, *University of Basel & Max Planck Institute for Human Development, Berlin*, ANDREAS PEDRONI, RUI MATA, JÖRG RIESKAMP, *University of Basel*, RALPH HERTWIG, *Max Planck Institute for Human Development*.

Assessing "risk attitudes" is the goal of practitioners and scientists alike. Over the last decades, two different traditions of doing so have emerged: Self-reports vs. behavioral measures. The latter tradition rests on the assumption that "talk may be cheap" and monetary incentives are required to elicit a person's true risk attitudes. To date, however, the construct "risk attitudes" still remains poorly understood, in particular because few studies have investigated how different measures relate to each other – both within but also across these two traditions. We have thus implemented a large battery of common risk-attitude measures in the context of one study, with 1,000 participants completing a day-long lab-session. We observed a clear gap between self-reports and behavioral measures, and correlations were particularly low between different behavioral measures. The former also generalized better to reported frequencies of real-life risk-taking behaviors (e.g., substance use). With a subsample, we also analyzed the measures' test-retest reliability, internal consistency, and discriminability between risk-

seeking and risk-avoiding persons. In general, self-reports scored better on these test-theoretic criteria than behavioral measures. The latter differed substantially in terms of retest-reliability, but not necessary in terms of internal consistency. These results suggest that behavioral measures may be particularly prone to the influence of situational factors (e.g., the current affective state). As such, they may be considered “contextualized measures” that capture moment-by-moment variation in risk attitudes. Self-reports, in contrast, may allow people to integrate across multiple past situations and are thus better suited as relatively stable, “decontextualized measures” of risk attitudes.

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### The Involvement of Functional Connectivity from Insular and Ventrolateral Prefrontal Cortices in Self-Reported Gambling-Related Cognitive Biases.

JOSÉ C. PERALES, JUAN F. NAVAS, CRISTIAN MARTÍNEZ RUIZ DE LARA & ANA PERANDRÉS, *University of Granada*.

**Background.** Gambling-related biases are pervasive in pathological gamblers, and are crucial in their treatment. However, little is known about their biological underpinnings. Available studies attribute an important role to ventrolateral prefrontal cortex (VLPFC) and insula. —**Aims.** (1) To evaluate differences between pathological gamblers (PG) and healthy controls (HC) in resting-state connectivity from vLPFC and insular seeds. (2) To explore PGs’ correlations between cognitive distortions and seed-based connectivity. —**Methods.** We used resting-state functional connectivity MRI to assess differences between 25 PGs and 23 controls. Seeds were located at VLPFC and insula. Seeds’ connectivity was regressed over a composite index of illusion of control, predictive control and interpretative bias. —**Results.** Gamblers showed increased connectivity in a network involving the right insula/vLPFC and ipsilateral lateral prefrontal, insular, and temporal cortices. PGs’ biases inversely correlated with (1) connectivity between right insula and left inferior frontal gyrus, and bilateral posterior parietal cortex; (2) connectivity between rVLPFC and right hippocampus (extending to OFC/insula), and left hippocampus/parahippocampus; and (3) lVLPFC connectivity towards the right middle frontal gyrus (extending to ACC), and left middle frontal gyrus. —**Conclusions.** Results from connectivity analysis revealed differences in functional organization of VLPFC/insula between PGs and HCs. Additionally, stronger biases predicted disconnection between these seeds and areas involved in cognitive control, memory, and motivation driven learning.

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## FALLA ROOM, SUNDAY 8TH MAY, 11:00-12:40 TS40 Bilingualism II

### The Representation of Trilingual Lexico-Semantic Memory.

AGNIESZKA EWA TYTUS, *University of Mannheim*.

A growing number of multilingual speakers poses an interesting question to the way in which three or more languages are represented in the memory of a language user. The bilingual lexical memory models, e.g. the Distributed Feature Model (de Groot, 1992), the Revised Hierarchical Model (Kroll & Stewart, 1994), the Sense Model (Finkbeiner et al., 2004), and the Shared Asymmetrical Model (Dong et al., 2005) skillfully capture the prediction regarding two languages, with the lexical level being separate and the conceptual level being distributed to a varied degree. In this study, we employed a masked priming paradigm in the form of an animacy decision task to address the conceptual representation of trilingual German, English, French speakers. The comparison of reaction times and error rates has revealed that priming effects have been observed from the more dominant language direction to less dominant ones (L1-L2, L1-L3, and L2-L3); however, no priming has been demonstrated in the opposite language directions. This result is in line with the priming asymmetry hypothesis (Jiang, 2000, 2002). The findings obtained in this study served as a ground for introducing a modification/extension to the Shared Asymmetrical Model (Dong et al., 2005). To the best of our knowledge this study is the first attempt of trying to model a trilingual lexical memory.

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### Learning Nouns and Verbs in a Foreign Language: The Role of Gestures in Vocabulary Acquisition.

ANA BELÉN GARCÍA-GÁMEZ, PEDRO MACIZO, *University of Granada*.

We examined the role of iconic gestures during the learning of words in an artificial language (Vimmi). We compared also the learning of words whose meaning was strongly or weakly related to motor actions (verbs and nouns respectively). Spanish monolinguals learned word pairs (Spanish – Vimmi words) during three consecutive days. In the training protocol participants produced the novel words (i.e., “kudi”, meaning “match” in Vimmi) at the time they performed a congruent gesture (the act of lightening a match) an incongruent gesture (e.g., the act of playing flute) or a meaningless gesture. The learning progress was evaluated by asking participants to translate words from Spanish to Vimmi and vice versa. Overall, compared to the learning of words without gestures, the production of congruent gestures facilitated vocabulary acquisition across the training sessions. However, the production of incongruent and meaningless gestures interfered with the learning task. These results suggest that the role of gestures depends on the match between the meanings associated to gestures and words. Email: Pedro Macizo, [pmacizo@ugr.es](mailto:pmacizo@ugr.es)





### Production Costs after Brief Exposure to an Unknown Language.

TAMAR DEGANI, *University of Haifa*, HAMUTAL KREINER, *Ruppin Academic Center*. We examined how production in one language is affected by recent brief experience with an unknown language. In a recent study (Kreiner & Degani, 2015) we found that tip-of-the-tongue rates of native Hebrew speakers were higher in a Hebrew picture-naming task following exposure to a short movie in an unknown language (Russian). We speculated that brief exposure works to change the accessibility of one's native language because speakers engage in (the earliest stages of) language learning. Here we probed this hypothesis, and examined Hebrew picture-naming accuracy and RTs of a comparable group of native Hebrew speakers before and after short (10 minute) exposure to Russian. Critically, we manipulated the ease with which speakers could engage in language learning by exposing half of the speakers to a Russian movie and half to the audio only of the same movie, predicting more learning and thus worse native language performance under the movie condition relative to the audio condition. Further, we collected individual-difference measures of auditory statistical-learning to test whether individuals who are better language learners suffer a greater hit to their native-language. Preliminary results support a link between language learning and the detrimental effect of brief exposure to an unknown language. Production latencies in the native language were higher following brief exposure to an unknown language, and this effect was associated with greater statistical-learning abilities. These findings underscore the dynamic nature of the language system and suggest that native language performance may be affected as soon as language-learning begins.

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### Statistical Learning Biases Predict Second-Language Reading Patterns.

LUCA ONNIS, *Nanyang Technological University*, STEFAN FRANK, *Radboud University*, HONGOAK YUN, *Konkuk University*, MATTHEW LOU-MAGNUSON, *Nanyang Technological University*.

Statistical learning (SL) is increasingly invoked as a general-purpose mechanism underlying language learning in infancy and childhood, and language processing in adulthood. One particular source of statistics to which participants in Artificial Grammar Learning (AGL) experiments are sensitive, is the transitional probability between units of the artificial language. A previous AGL study found a language-specific "SL bias": English-speaking adults segment an ambiguous speech string such that words' transitional probabilities are consistent with the head-initial structure of English, whereas Korean-speaking adults favour a different segmentation, consistent with the head-final structure of Korean.

In the current study, we investigate how this SL bias affects second-language processing. Using the above mentioned AGL task, we assessed the SL bias of 58 adult Koreans who were advanced speakers of English as a second language. The same participants then performed a self-paced reading task on a general sample of English sentences. Word-reading times were analysed by linear mixed-effects regression, including as predictors: base frequency and forward transitional probability of the word, participant's SL bias and L2 proficiency, as well as several covariates.

We found that individuals with a more "English like" SL bias more efficiently incorporated statistical regularities during online reading, in that their word-reading times were significantly more

sensitive to the words' forward transitional probability as opposed to base frequencies. These findings further support the view that statistical learning skills underlie not only language learning in childhood, but also second language processing in adults.

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### Which Aspects of Linguistic Experience Help to Tune the Bilingual Comprehension System?

MELINDA FRICKE, JUDITH F. KROLL, PAOLA E. DUSSIAS, *Pennsylvania State University*.

Previous work has demonstrated that cross-language activation during bilingual speech planning can result in subtle changes to phonetic production. In a series of experiments, we asked whether listeners of different language backgrounds could exploit the distributional information available in the acoustic signal to predict when a codeswitch is about to happen. The visual world paradigm was used to examine the time course of auditory word recognition in Spanish-English bilinguals. Target words were presented in codeswitched sentences either with or without anticipatory phonetic cues signaling the upcoming switch: e.g., listeners were instructed to "click on the picture of the *pato* (duck)" and in the "cued" condition, the voice onset time in "click" and in "picture", and the speech rate of the carrier phrase were all decreased slightly. Habitual codeswitchers from the Penn State community demonstrated more robust activation of the target word and decreased interference from an interlingual distractor (e.g., fewer looks to a pot) on trials with phonetic cues. Ongoing analyses will compare these results to those of similarly proficient bilinguals from the Penn State community who do *not* regularly engage in codeswitching, and to habitual codeswitchers from El Paso, Texas with varied dominance profiles, allowing us to investigate the extent to which language dominance versus language switching experience promote sensitivity to distributional information that can facilitate language regulation. An adapted version of the experiment is also underway to address the question of whether monolingual English speakers can learn to tune in to the relevant cues when given targeted training.

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ANDALUCIA III ROOM,  
SUNDAY 8TH MAY, 10:40-12:40  
**TS41 Attention II**

### Biased Attention to Alcohol Cues: Gender Differences in a Risk Factor for Alcohol Abuse.

MARK T. FILLMORE, MCKINLEY PAIGE POTTER, RAMEY MONEM, *University of Kentucky*.

Attentional bias towards alcohol-related stimuli is shown by stimulus presentation tasks that show subjects have longer fixation times to alcohol versus neutral images. Attentional bias is observed in heavy drinkers and alcoholics and is thought to reflect increased motivation to drink. Little is known about gender differences in attentional bias. Studies do show that alcohol produces greater impairment of selective attention in women than in men. Alcohol-related cues could be more difficult for female drinkers to ignore, making attentional bias a greater risk factor for heavy drinking in women. The present study tested this hypothesis. 185 adult alcohol

drinkers (120 men and 65 women) between the ages of 21 and 45 years completed measures of past alcohol use and had their attentional bias to alcohol assessed by a visual dot probe task. Results showed that on average, men and women displayed similar degrees of attentional bias to alcohol. However, individual differences in attentional bias were a stronger predictor of alcohol consumption patterns for women than for men. For women, greater attentional bias was associated with drinking more often and consuming more drinks per occasion. No such relationships were observed for men. Together, the findings suggest that changes in attention to alcohol cues could be an especially important and perhaps early indicator of alcohol use disorders in women.

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### Attentional Templates for Integrated Colour Objects: Behavioural and Electrophysiological Evidence.

NICK BERGGREN, MARTIN EIMER, *Birkbeck College, University of London.*

Holding a target feature in mind results in attentional biasing towards objects containing that feature. While the capacity of these attentional templates is often assumed to be restricted to a single feature, recent evidence suggests that multiple templates may operate independently (e.g., separate templates for the colours red and green). Here, we examined whether multiple templates can be combined in an integrated template. In a spatial cueing task, participants searched for colour-defined targets that were preceded by irrelevant spatially uninformative colour cues. In Experiment 1, targets were dual-colour objects (e.g., red and green). In Experiment 2, dual-colour targets were defined by their specific spatial configuration (e.g., red above green). N2pc components to colour cues and behavioural spatial cueing effects were measured to assess attentional capture by fully or partially target-matching cues. In Experiment 1, only cues containing both colours triggered positive behavioural cueing effects. In Experiment 2, cueing effects were larger for fully target-matching as compared to colour-rotated cues (e.g., green above red). These behavioural results suggest that attention can be controlled by integrated templates. However, significant N2pc components were triggered not only by fully matching but also by partially matching cues in both experiments. This dissociation between electrophysiological and behavioural markers of attentional capture shows that the initial stage of attentional control is based on independent feature-specific templates, and that the selection of targets defined by a specific colour conjunction or configuration results from a rapid withdrawal of attention from partially matching non-target objects.

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### Figure-Ground-Segmentation Modulates Stimulus-Response-Binding.

CHRISTIAN FRINGS, *University of Trier*, KLAUS ROTHERMUND, *University of Jena*. Integrating features of responses and features of stimuli helps to control action in complex environments. Such stimulus-response bindings encode information at multiple levels of abstraction, furnishing considerable flexibility and context-sensitivity in their deployment. Still, it remains unclear how the cognitive controls such bindings. Are all features of all stimuli automatically integrated with the response? If so, many incompatible bindings would emerge and as a consequence binding would often produce inefficient performance. We suggest that

figure-ground segmentation processes can control and modulate automatic binding processes in a bottom-up and effortless way. In two experiments ( $N = 32$ ,  $N = 33$ ) using a distractor-to-distractor priming paradigm, we show that the figure-ground principle of 'size of area' and the principle of 'lower ground' modulate stimulus-response bindings. In particular, features that according to figure-ground segmentation belong to the background are not integrated into stimulus-response episodes. We conclude that figure-ground segmentation offers a mighty tool to improve performance beyond perceptual processing but instead also affects action control.

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### Identity Information Is Extracted Only from the Currently Foveated Object during Multiple-identity Tracking: An Eye-tracking Study.

LAURI OKSAMA, *National Defense University/Academy of Finland*, JIE LI, *Beijing Sport University*, JUKKA HYÖNÄ, *University of Turku.*

Some investigators argue that visual tracking is based on a parallel mechanism, others argue that tracking contains a serial component. In Experiment 1, we put previous theories into a direct test by registering observers' eye movements when they tracked identical moving targets or when they tracked distinct object identities. We found a qualitative difference between these tasks in terms of eye movements. When the participants tracked only position information, the observers had a clear preference for keeping their eyes fixed for a rather long time on the same screen position. In contrast, active eye behaviour was observed when the observers tracked the identities of moving objects. Experiment 2 investigated how observers extract identity information during multiple-identity tracking by adopting the gaze-contingent display technique. We manipulated in real time the presence/absence of the object identities while the participants tracked multiple moving objects. The results showed that when only the identity of the currently foveated object was presented, participants' tracking performance was as good as when the identities of all the objects were presented all the time. Moreover, when identity information was not available when the target was foveated, the performance dropped to the level observed in the condition where the object identities were presented only prior to object movement. The results yield strong support for the view that identity information of multiple moving objects is extracted in a serial manner during identity tracking, whereas the positions of identical moving targets can be tracked in parallel without the need of eye movements. Email: Lauri Oksama, [loksama@utu.fi](mailto:loksama@utu.fi)

### Target Salience Reduces the Efficiency of Parallel Visual Processing.

JASON S. MCCARLEY, RAN WEI, *Flinders University.*

Adaptive behavior often requires us to divide attention across multiple information sources in parallel. Surprisingly, recent data (Yamani et al., 2015, *ASP*) have suggested that the ability to process multiple visual signals simultaneously improves under high perceptual demand; parallel processing efficiency, as measured by the workload capacity coefficient  $C(t)$  (Townsend & Eidels, 2011, *PBR*), was higher in cluttered than in uncluttered displays. The current work aimed to replicate this effect and test whether the effects of clutter on  $C(t)$  were driven by bottom-up or top-down attentional processes. Participants ( $N = 14$  young adults) performed



a speeded identification task in a visual redundant-targets paradigm. In the *uncluttered* condition, red or green target(s) appeared alone in the display. In the *pop-out* condition, the target(s) appeared surrounded by distractors of the alternative color. In the *uniform* condition, the target(s) appeared surrounded by distractors of the same color. As expected, RTs were shortest in the uncluttered and pop-out conditions.  $C(t)$ , however, was greatest in the uniform condition, in which bottom-up control was ineffective for selecting target(s) from distractors. A follow-up experiment confirmed that differences in  $C(t)$  between conditions were not simply the result of differences in mean RT. Results suggest that bottom-up processes reduce the efficiency of parallel target processing, perhaps by producing competition for selection between targets.

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### **The Influence of Similarity, Identifiability, and Memory on Change Deafness for Environmental Sounds.**

KELLY DICKERSON, JEREMY R. GASTON, BRANDON S. PERELMANM, TIMOTHY MERMAGEN, ASHLEY N. FOOT, *Army Research Laboratory*.

Change deafness describes failures to notice changes in auditory scenes; however, there is limited information on the underlying causes that drive this effect. The present study examines the effects of stimulus similarity and identifiability on listeners' ability to discriminate changes in auditory scenes. To evaluate these effects, a set of environmental stimuli was characterized using measures of pairwise similarity and free identification. In experiment 1, 10 listeners rated 25 environmental sounds on a scale of 1-7 for their overall similarity. The same listeners also performed a free identification task for each of the sounds. The similarity data were subject to a multidimensional scaling analysis, and the results of the free identification task suggest a wide range of identification accuracy ( $M_{accuracy} = .70$ , Range .15-1.00). These data are used in a follow-up analysis of experiment 2. In experiment 2, 23 listeners performed an AX (same-different) change discrimination task paired with a trial-by-trial cued recall task. In general, errors increased as similarity between the change and the background increased. Counterintuitively, the ability to identify a sound was inversely related to change errors; hard-to-identify sounds were more easily discriminated from the background. These results suggest that identity information may interfere with change discrimination. Performance on the cued-recall task was poor, and generally correlated with change discrimination, with one notable exception; difficult to identify sounds were hard to remember, but easy to pick out as the source of a change. These results suggest that a global listening strategy may be aid change discrimination.

MACHADO ROOM,  
SUNDAY 8TH MAY, 11:00-12:40  
**TS42 Memory IV**

### **A Computational Account of the Production Effect in Recognition Memory.**

RANDALL K. JAMIESON, *University of Manitoba*, D. J. K. MEWHORT, *Queen's University at Kingston*, WILLIAM E. HOCKLEY, *Wilfrid Laurier University*.

People remember words they say aloud better than ones they do not, a result called the production effect. The standing explanation for the production effect is that producing a word renders it distinctive in memory and thus memorable at test. Theorists have argued that the distinctiveness conferred by production can be represented in terms of additional memorial features that correspond to auditory and motor feedback arising in the productive act. We formalize the sensory-feedback account in a standard model of memory, MINERVA 2. The model accommodates the production effect in recognition memory including the fact that the production effect is larger in mixed- than pure-list experimental designs, that the production effect arises given item-specific but not item-general production, and that the production effect is robust to forgetting. We show the utility of the computational analysis by formalizing distinctiveness and strength and showing that the two are deeply confounded. The analysis provides the means to disentangle or at least control the two factors in future experiments. We discuss the production effect as an example of how psychology has neglected the responsibility of building a general theory of memory in favour of developing a collection of disjoint and specialized accounts of particular phenomena.

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### **Guided Memory Search: Results from Concurrent Visual and Memory Search Through Different Categories.**

MARIA NORDFANG, *University of Copenhagen*, JEREMY WOLFE, *Harvard Medical School, Brigham & Women's Hospital*.

It is well established that visual search can be guided by a target held in memory. The reverse situation is less well understood: If several targets are held in memory, can memory search be guided by items in the visual display, limiting memory search to items relevant to the current visual display? Recent results from hybrid visual and memory search suggest that participants are able to avoid searching memory when the attended visual item is dissimilar from all the items in the memory set (Cunningham & Wolfe, 2014). However, we do not know whether the visual items can guide memory search such that more relevant items are prioritized over less relevant. We investigated this through three behavioral experiments in which participants memorized sets of items that belonged to one or two categories (e.g., animals and signs; Experiment 1a and 1b) or one, two or four categories (e.g., characters, animals, scenes and drawings; Experiment 2). Participants were asked to determine if any of the items from their memory set were present in visual displays that could contain items from one or from several of the categories in that current memory set. Overall, the results demonstrated that participants had some ability to guide their memory search based on the items in the visual display. However, the results also demonstrated that this memory guidance is not perfect and that the memory guidance is less efficient than visual

guidance in our experiments.

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### The Writing Superiority Effect across Knowledge Domains.

JOACHIM GRABOWSKI, *Leibniz University of Hanover*, MARKUS JANCZYK, *University of Tübingen*.

It is still controversial whether oral and written recall lead to equivalent assessment in the diagnosis of underlying knowledge. There is research assuming a superiority of oral accounts of events; other findings refer to congruency between encoding and retrieval phases, while a writing superiority effect is repeatedly reported for list-like knowledge. Here, we show that at least for previously existing (i.e., not experimentally induced) knowledge domains written recall is strongly superior. In three experiments, two groups of participants (from different populations across experiments) freely recalled all items they knew on a given category either orally or in the written mode. Hereafter, all participants performed a cued recall test on the respective domain in order to estimate their maximum knowledge. A writing superiority effect is present when the difference between cued recall and free recall results is larger in oral than in written mode. This has been the case for the domains of annual Christian holidays ( $t(26) = 2.89, p = .004$ ), chemical elements (experts:  $t(29) = 2.88, p < .01$ ; laypersons:  $t(28) = 2.05, p = .05$ ), and the states of the USA ( $t(38) = 1.86, p < .05$ ). For list-like knowledge domains, the writing superiority effect can thus be considered assured. Explanations of the effect relate to the preferential and spreaded accessibility of orthographic representations. Moreover, written recall appears to be slower not only for the execution (speaking is generally faster), but also for overall retrieval time, indicating different cognitive “modes” for written and oral recall.

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### Recognition Memory for Faces and Pictures of Faces: Facial Information Is Recollected While Picture Information Is Familiar.

GRAHAM MACKENZIE, GEORGIA ALEXANDROU, PETER J. B. HANCOCK, DAVID I. DONALDSON, *University of Stirling*. Recognition memory for pictures of unfamiliar faces can be achieved by retrieving facial information or pictorial information. If different pictures of the same faces are used in study and test phases, however, recognition is more likely to be supported by retrieval of facial information because of pictorial changes. Event-Related Potential studies of recognition memory have identified dissociable old/new effects linked with retrieval processes known as familiarity and recollection. Familiarity involves assessing an item’s memory strength while recollection supports retrieval of contextual information. A recognition memory task using photographs of unfamiliar faces was performed to investigate the contributions of familiarity and recollection to retrieval of facial and pictorial information. It was predicted that using a different photo at test would force participants to use recollection to retrieve facial information, whereas using the same photo at test a combination of familiarity and recollection would support performance. Participants studied 200 faces and across ten test phases discriminated between 100 same photo, 100 different photo and 200 new faces. Memory for same photos was superior

to different photos. ERPs showed anterior old/new effects for both same and different photos but same photos were associated with additional posterior activity. These anterior and posterior ERP old/new effects have been linked previously with recollection and familiarity, respectively (MacKenzie & Donaldson, 2007; 2009). Superior performance for same photos appears to be linked with additional familiarity for picture information, while recognition memory for unfamiliar faces is supported by recollection.

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### The Memory of Ensemble Mean Is Better for Peripheral than Perifoveal Objects.

YOSHIYUKI UEDA, *Kyoto University*.

We do not usually recognize all the objects that we see explicitly because vision always receives massive information. Instead of recognizing individual objects, we extract statistical information. In the previous study, it was found that the average of a stimulus set is automatically calculated and implicitly stored, which it leads to a preference for the average (Ueda, 2015). In the present study, I presented stimulus sets either peripherally or perifoveally, to investigate whether the intensity of memory differs in these two conditions. In the exposure session, participants were repeatedly presented 12 circles with four kinds of average size. During this session, participants were asked to detect the red colored fixation, which continuously changed at about every 500 ms (independent of the circle presentation), and press a key as soon and as accurately as possible, ignoring the circles. The circles were presented peripherally in Experiment 1, while perifoveally in Experiment 2. In the preference session, two circles (one of the average size, and the other a little larger or smaller than it) were presented to participants and they were asked to choose a preferred circle. Note that the circle with the average size was not actually presented in the exposure session. Nevertheless, observers showed their preference for the average sized circle. Furthermore, this effect was more intense when the circles had been presented peripherally in the exposure session. These results suggest that the memory of ensemble mean may be formed automatically during a peripheral rather than perifoveal presentation.

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PICASSO ROOM,  
SUNDAY 8TH MAY, 11:00-12:40  
TS43 Learning

### Slowed Reacquisition after a Partial Extinction Treatment: Relapse Attenuation in Human Contingency Learning.

FRANCISCO J. LÓPEZ, *University of Malaga/Institute of Biomedical Research in Malaga*, JOAQUÍN MORÍS, *University of Oviedo*, ITXASO BARBERIA, *University of Barcelona*, MIGUEL A. VADILLO, *King’s College London*, AINHOA ANDRADES, *University of Malaga*.

Extinction-based therapies constitute the most widespread empirically validated treatment of anxiety disorders. However, they face an important limitation, as relapse often takes place once the extinction procedure has been completed. In the present experimental series, we showed the first demonstration of relapse





reduction, a slowed reacquisition, in human contingency learning after a partial extinction procedure using mild aversive stimuli. This effect was specific of the partial extinction treatment (i.e., reinforced trials were occasionally experienced during extinction; Experiment 1) and not only due to differences in uncertainty levels between the partial and a standard extinction group (Experiment 2). Experiment 3 explored conditions in which partial extinction was complete, while the slowed reacquisition effect was still obtained. Potential uses of this strategy in anxiety disorders therapies, its theoretical explanation and its current limitations are discussed. Email: Francisco J. López, [frjlopez@uma.es](mailto:frjlopez@uma.es)

### **Bayesian Modeling of Human Contingency Learning Phenomena: An illustration with the Partial Reinforcement Extinction Effect (PREE).**

FERNANDO BLANCO, *Universidad de Deusto*, JOAQUÍN MORIS, *Universidad de Oviedo*. Introduction: Human contingency learning has greatly benefited from the use of different mathematical models. One type of model currently underrepresented in this area is Bayesian models, although they provide greater flexibility and the possibility of testing more complex structures than do traditional models. We provide a demonstration of these benefits by taking as an example the Partial Reinforcement Extinction Effect (PREE). The PREE is defined as a greater resistance to extinction observed when a partial reinforcement schedule was delivered during the acquisition phase. A Bayesian model, based on the assumption that extinction is not gradual, but takes place in two different states, with different moments of change between them, is proposed and described. Methods/Results: We conducted a simple PREE experiment with 55 participants divided in 3 groups, with probabilities of reinforcement during the initial training of 100%, 75% or 50%. We found slower rates of extinction for the groups with lower probabilities of reinforcement, replicating the standard PREE effect. In addition, our Bayesian model showed the expected differences in the moment of change between states for each of the groups. Discussion: We have provided a simple Bayesian model of a classical contingency learning effect with the objective of showing the benefits that this type of model can bring to the associative learning research field. Potential improvements and limitations are detailed, as well as its generalization of use. Email: Fernando Blanco, [fernandoblanco@deusto.es](mailto:fernandoblanco@deusto.es)

### **Prediction and Uncertainty: Examining Controlled and Automatic Components of Learned Attentional Biases.**

DAVID LUQUE, *UNSW Australia*, MIGUEL A. VADILLO, *King's College London*, MIKE LE PELLEY, TOM BEESLEY, *UNSW Australia*.

Evidence from human associative learning has shown that overt attention to stimuli (eye-gaze dwell time) is determined by both predictiveness and uncertainty (Beesley, Nguyen, Pearson & Le Pelley, 2015). Participants in these experiments spent more time attending to predictive over nonpredictive cues, and in addition more attention was paid to cues within compounds that had an uncertain relationship with outcomes. In two new experiments we further examined whether both predictiveness and uncertainty modulate attentional processing in an adaptation of the dot probe task. This task is thought to measure covert attention to cues during associative learning (Le Pelley, Vadillo & Luque, 2013). Results showed that the predictive status of cues determined selective

attention, with faster attentional capture to predictive than to nonpredictive cues. In contrast, the level of uncertainty slowed down responses to the probe regardless of the predictive status of the cues. These results suggest that uncertainty-driven (exploratory) and predictiveness-driven (exploitative) attentional biases can be automatically activated during associative learning.

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### **Contextual Cuing As a Form of Nonconscious Learning: Theoretical and Empirical Evidence in Large and Very Large Samples.**

BEN COLAGIURI & EVAN J LIVESEY, *University of Sydney*.

Many studies demonstrate that associative learning can affect visual cognition. In one such effect, search times for a target hidden among similar distractors are faster for repeated search arrays compared with novel search arrays. This contextual cuing effect is particularly interesting because researchers have routinely failed to find evidence of recognition of the repeated configurations, typically leading them to conclude that the cuing effect is a form of nonconscious learning. However, such conclusions have recently been criticized on a number of methodological and conceptual grounds that suggest the area suffers from a high probability of false negative results on awareness tests and misinterpretation of weak or absent relationships between cuing and awareness measures. To address this, we developed predictions from theoretical models assuming that either single or independent memory sources drive learning and awareness and evaluated how these predictions fair in three contextual cuing experiments involving large ( $n > 60$ ; Experiments 1 and 2) and very large samples ( $n > 600$ ; Experiment 3). The data suggest no relationship between awareness and the cuing effect both at the participant and individual configuration level, the probability of which being a false negative is very low in a model assuming a single memory source drives learning and awareness. This was the case using both conventional and Bayesian analyses. The combination of this theoretical and empirical analysis suggests that contextual cuing is not dependent on cue recognition and provides evidence that it reflects a genuine form of nonconscious learning.

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### **A Comparison of Conditioning the Human Pupil Using Brightness versus Affective Stimuli.**

FERDINAND PITTINO, KATRIN M. KLIEGL, ANKE HUCKAUF, *Ulm University, General Psychology*.

Autonomous responses (e.g. heart rate or galvanic skin response) can be conditioned (Lennartz & Weinberger, 1992). However, there is still an ongoing debate about conditioning the human pupil. Whereas stimuli paired with shock and reaction time tasks showed a conditioned dilation response (Lennartz & Weinberger, 1992; Reinhard & Lachnit, 2002), conditioning using brightness revealed mixed results (dilation or constriction; e.g. Kugelmass, Hakerem, & Mantgiaris, 1969; Voigt, 1968). Therefore, in the present study we aimed at exploring conditioning of the pupil. A classical conditioning setting with unconditioned stimuli (UCS) differing in brightness was used as well as an evaluative conditioning setting using negative and neutral pictures as UCS. In each setting, 16 participants rated the conditioned stimuli regarding valence and arousal. Before conditioning, neither the pupillary response nor the ratings differed between the different conditioned stimuli (CS).

After both kinds of conditioning, one CS was rated more negative and more arousing and showed a more marked dilation response than the counterpart: In classical conditioning, larger pupils and higher ratings were unexpectedly observed for bright conditioned relative to dark conditioned stimuli. In evaluative conditioning, larger pupils and higher ratings were observed for negative (relative to neutral) conditioned stimuli. These results are discussed with regard to differences between evaluative and classical conditioning and an affective modulation in conditioning.

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## MACHUCA ROOM, SUNDAY 8TH MAY, 11:00-12:40 TS44 Neural Substrates

### EEG Complexity in Mind Wandering and Externally Focused Attention modelled with Whole-Brain Computational Connectomics.

ANTONIO IBÁÑEZ-MOLINA, SERGIO IGLESIAS-PARRO, *University of Jaén*.

Mind wandering (MW) and externally focused attention (EA) are competing states in which attention is directed to either internally or externally generated thoughts respectively. From the perspective of macroscopic neural dynamics, MW has been related with the activation of the Default Mode Network (DMN), while EA has been associated with a Salience Network (SN) that is functionally anti-correlated with the DMN. In order to explore a plausible mechanism between the DMN and the SN that give rise to MW and EA transitions, we designed a whole-brain model based on 66 weakly coupled Kuramoto oscillators. Each oscillator modelled the dynamics of a particular region of the cortex. The structural connectivity between the oscillators was selected from diffusion tensor imaging of healthy participants. External stimulation was simulated in this network model for two opposite conditions. Stimuli could be presented when oscillators in the SN were more synchronized than in the DMN, or, on the contrary, when synchrony in the SN was lower than in the DMN. After 15 repetitions of each condition, the output phases of the oscillators were used to simulate EEG signals. The analyses of the EEGs showed that the structural complexity from both simulated and real data was higher when the model was stimulated during periods in which DMN was more synchronized than the SN. Overall, our results provided a plausible mechanistic explanation to MW as a state in which the dynamics of a highly synchronized DMN might suppress the processing of external events.

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### Neural Substrates of Hierarchical Timing Control in Experts and Novices.

RALF T. KRAMPE, *University of Leuven*, NICOLE WENDEROTH, *ETH Zuerich*, ANN LAVRYSEN, STEPHAN SWINNEN, *University of Leuven*.

Rhythmic timing is a key component of musical expertise as well as part of the normal behavioral repertoire. Effects of task complexity and adult-age related changes in timing accuracy are explained by the Hierarchical Timing Control model (HTC), which distinguishes

low-level timing, sequencing, and task-set control levels. To determine the neural substrates of HTC levels we collected whole-brain functional scans from four groups of young ( $M=26.09$  yr.) and older ( $M=61.62$  yr.) professional musicians and age-matched novice controls ( $N=20$  per group). Participants tapped rhythmic sequences with a wrist orthosis while lying supine in the scanner. Behavioral data showed the expected age  $\times$  expertise interaction with older experts clearly outperforming young novices. Results from far-transfer task (Go-NOGo) indicated experts and novices were similar regarding domain-general processing speed, working memory, and cognitive control. fMRI data revealed a typical sensorimotor network for low-level timing, a parietal-premotor network for sequencing, and extensive prefrontal activation for the most complex timing tasks in novices. Low-Level timing activation was similar in experts, however, for complex rhythm tasks experts relied on specific premotor and SM1 areas. Results support the HTC model at the neural level and they dissociate expert and novice neural mechanisms.

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### Zen Meditator Overcomes the Stroop Interference: An fMRI Study of Access Consciousness.

NAOYUKI OSAKA, *Kyoto University*, TAKEHIRO MINAMOTO, *Osaka University*, KEN YAOI, *Kyoto University*, MUYUKI AZUMA, MARIKO OSAKA, *Osaka University*.

Meditation is one of the most interested issues in recent consciousness and mindfulness research. Zen meditation “the practice of attending to current moment experience allowing emotions and thoughts to pass without judgment” has shown to be beneficial in populations involving mindfulness. However, neural correlates of access consciousness by which Zen operates remain unexplored. One of the most basic forms of Zen meditation is concentration meditation, in which sustained attention is focused on the one’s rhythmic breath and accept the environmental world as it is, shedding their own bias that is often mediated by language such as color name.

The task is a suitable one to investigate color-word interference effect, as the task requires to focus on the color while ignoring word meaning. Neural correlates of access consciousness of 19 trained Zen meditators from the school of the Rinzaï and age- and education-matched healthy volunteers were investigated using fMRI under the color Stroop interference task. The task consisted of congruent-, incongruent- and neutral-block. In the congruent block, color name of target words was congruent with color ink while color name of targets was incongruent with ink in the incongruent block.

We found professional Zen meditators overcome the interference under incongruent condition by showing high correct performance with less increase of brain’s BOLD signal in medial prefrontal cortex and anterior cingulate cortex, both of which correlates with inhibitory function under cognitive conflict. Thus, Zen meditator assumed having an effective executive function for cognitive inhibition.

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### Attention Shapes Category Representations in the Hippocampus.

BRADLEY C. LOVE, *University College London*, MICHAEL L. MACK, ALISON R. PRESTON, *University of Texas at Austin*.

Attention shapes what we learn and remember. In particular, attentional tuning of hippocampal memory processes is a common thread across learning theories, yet empirical evidence for such influence is equivocal. Here, we combine computational modeling with neuroimaging to test whether hippocampal representations are shaped by attention across changes in learning contexts. Participants learned two classification tasks in which optimal learning required different attentional strategies. We quantified attention-weighted knowledge representations underlying each participant's learning behavior with a computational model. Using representational similarity analyses, we demonstrate that neural representations in left anterior hippocampus correspond with model predictions of attention-biased representations. Moreover, we show that early in learning, the hippocampus is functionally coupled with frontoparietal regions with the degree of interaction predicting individual differences in learning performance. Based on these findings, we propose that attention-biased conceptual representations are dynamically formed and updated by the hippocampus in concert with frontoparietal regions for efficient learning.

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ALBENIZ ROOM,  
SUNDAY 8TH MAY, 11:20-12:40  
**TS45 Decision Making II**

### Toward a Psychology of Surrogate Decision-Making.

RICHARD J. TUNNEY, *University of Nottingham*, FENJA V. ZIEGLER, *University of Lincoln*.

Many of the decisions that we make in everyday life are made for the benefit of other people. However, research suggests that people often make decisions on behalf of other people that are different from those that the other person would choose for himself or herself. This raises practical problems in the case of legally designated surrogate decision-makers who may not meet the legal normative benchmark — the substituted judgment standard. We review evidence from our own and other studies of surrogate decision-making and examine how closely surrogate decision-making matches the recipient's wishes, or if it is an incomplete or distorted application of our own decision-making processes. To date there exists no domain general model of decision-making on behalf of other people. On the basis of the evidence that we review we propose a framework by which surrogate decision-making can be assessed and a novel domain general theory as a unifying explanatory model of the surrogate decision-making process.

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### Reward-Related Decisions from Description and Experience: Contributions of Common and Distinct Valuation Processes.

CHRISTOPHER R. MADAN, *Boston College*, ELLIOT A. LUDVIG, *University of Warwick*, MARCIA L. SPETCH, *University of Alberta*.

People's risk preferences differ for choices based on described probabilities versus those based on information learned through experience. For decisions from description, people are typically more risk averse for gains than losses. In contrast, for decisions from experience, people are sometimes more risk seeking for gains than losses, especially with the possibility of extreme outcomes. One outstanding question is whether these two types of decisions reflect separate or overlapping processes. As in previous studies, people were more risk seeking for losses than for gains in description but showed the opposite pattern in experience. Despite this overall difference, risky choice for both decision types was positively correlated: people who were more risk seeking in description were also more risk seeking in experience. This finding suggests that both types of decisions reflect a set of common processes. However, post-choice memories for past outcomes correlated with decisions from experience but not with the described choices, implying that the overall differences in risk preference are due to the differential impact of memory.

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### Economists' Decision Making: Cheaters with Altruistic Instincts.

DAVID PASCUAL-EZAMA, *Universidad Complutense de Madrid*, NORA MUÑOZ, *Centro Universitario de Estudios Financieros (CUNEF)*, DANIEL F. RIN, BEATRIZ GIL-GÓMEZ DE LIAÑO, *Universidad Autónoma de Madrid*.

Based on an experiment conducted with undergraduate students from three different majors (business economics, psychology and engineering), we study the relationship between honesty and altruism. We asked participants to toss a coin with a black and a white side. Participants won a chocolate if they reported the white outcome, whereas no gift was given if they reported black. It was done privately, so they could decide whether or not to cheat. Reporting the prize-losing side (that is, being honest when losing) could result in 3 effects, depending on the 3 conditions run: (i) no penalty, (ii) paying a penalty, or (iii) paying a penalty with an altruistic end (a donation to a non-profit organization). Each participant decided the amount of penalty and the payment was also done in private. Although we cannot detect dishonesty on an individual level, we use statistical inference to determine cheating behavior. We find suggestive evidence that economics is significantly the most dishonest major when no penalty is involved. With economists in the lead, the results also indicate that all majors cheat if a penalty is requested. Surprisingly, when altruism plays a role, economists tend to have the most altruistic behavior, followed by psychologists. However, altruism does not reduce engineers' propensity to lie. No significant differences are found regarding gender.

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**Judging risks in different domains: The ratio bias vs construal level theory revisited**

VOLKER THOMA, *School of Psychology, University of East London.*

Research on the ratio-bias (RB) phenomenon finds that statements such as “100 people die from cancer every day” should be judged as less risky than “36,500 people die from cancer every year”.

Explanations include a focus on the nominator (ignoring the denominator) or anchoring effects. However, construal level theory (CLT) states that near events (“every day”) are mentally represented as more concrete, and specific, and therefore judged as riskier than far, abstract events (“every year”). The predictions of CLT and RB are directly opposed for such statements, and Bonner and Newell (2008) found that participants followed the RB when judging risks. Two studies investigated the role of cognitive reflection, numeracy, age, concreteness, and type of domain on risk judgments, using standard scales. In online questionnaires 152 participants were presented with 16 statements on risks in the health domain and public spending cuts and rated them on a 25-point Likert scale. The results showed that participants’ perception of risks followed the RB, and that younger people (age >40 years) judged public budget cuts as more risky, with numeracy a significant co-variate. A second lab-based study with fifty-one participants found similar results, with the additional finding that manipulating the salience of the numerator had no effect. These results are not easily explained by a role of concreteness of risk information or by an anchoring explanation for the RB, and indicate the importance of personal relevance in risk judgments.

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# POSTERS





CENTRAL HALL,  
THURSDAY 5TH MAY, 17:00-19:00  
POSTER SESSION I

### Animal Research

(1)

#### **Latent Inhibition or Facilitation: The Effect of CS Preexposure in Flavour-Preference Learning Depends on the Hedonic Value of the Flavour.**

ENRIQUE MORILLAS, FELISA GONZÁLEZ, *University of Granada*, GEOFFREY HALL, *University of York and University of New South Wales*.

Presentation of a cue without consequence will retard subsequent cue-outcome learning. This latent inhibition effect is robust and found in almost all conditioning paradigms. Flavour-preference conditioning appears to be an exception. In rats that are not hungry, a preference based on pairing a flavour with a palatable taste such as sucrose does not show latent inhibition (Garcia-Burgos, González, & Hall, 2013). Even more surprising, when rats are hungry, preexposure to a flavour may produce a reversal of latent inhibition, i.e., facilitation of preference conditioning (González, Morillas, & Hall, 2015). The experiments reported here investigate this latter effect and show it to depend on the nature of the flavour. Subjects were naïve male Wistar rats that were both food and water deprived. In each experiment half of the animals were exposed to the flavour CS (conditioned stimulus) before CS-US (unconditioned stimulus) pairings; the rest to water. The US was a 10% (w/v) sucrose solution; the CS was either a neutral (vanilla) or a nonpreferred (almond) flavour. Preference was assessed through two-bottle, flavour vs. water, choice tests given after conditioning. Latent inhibition was observed in experiments using a neutral flavour. However, with a less preferred one, facilitation instead of latent inhibition was evident, either across acquisition trials or during extinction testing. Unlike more conventional paradigms of Pavlovian conditioning, CS preexposure in flavour-preference learning may produce either latent inhibition or facilitation, depending on the hedonic value of the CS. Funding: Grant #PSI2012-33552 (MINECO, Spain).

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(2)

#### **Open Source Modelling of Associative Phenomena: Inhibition of Delay and SOP.**

JOAQUÍN MORÍS, *University of Oviedo*.

In the course of delay conditioning, a conditioned stimulus acquires the capacity to generate excitatory conditioned responses. However, if the conditioned stimulus has a long duration, its initial part can become inhibitory, in what has been called inhibition of delay. The study of this phenomenon provides very interesting information about the fine-grained details of conditioned response timing and the representation of stimuli. It has been claimed that recent versions of the SOP model can predict inhibition of delay and several of its most important properties (Vogel, Brandon & Wagner, 2003). An open source implementation of the SOP model will be presented. It was used to manipulate different parameters of the model in order to explore how SOP can describe inhibition of

delay, and its general predictions regarding this phenomenon. In all of the situations the fit was poor, in contrast with previous claims. Following this, the advantages of open source implementations for reporting, reviewing and replicating model simulations in associative learning are discussed.

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(3)

#### **The Effectiveness of Training Emotional Self-Regulation Techniques on Problem Solving Ability in Students of Yazd University of Science and Art.**

MARYAM PASYAR, *Azad University of Yazd*, MOHSEN SAEIDMANESH, *Yazd University of Sciences and Art*.

Introduction: This study aimed to investigate the effectiveness of training emotional self-regulation techniques on problem-solving ability among students of faculty of humanities in yazd university of Science And Art.

Method: the way of survey is quasi-experimental with pre-test & post-test by control and experimental group. For this purpose from students of the faculty of humanities 50 subjects were randomly selected as the sample and again at random 25 in experimental group and 25 in control group. First the problem solving inventories (PSI) were given to all of them as pre-test then experimental group were trained for 90 minutes in 8 sessions. At the end of training sessions (PSI) inventories were given to them for the second time as post-test and then they were scored using paired t-test and analysis of covariance by SPSS-16 software and then data analysis was performed.

Result: paired t-test on pre-test and post-test of experimental group, showed significant difference between the mean of experimental group, before and after the training. Training the techniques had positive effect On all subscales of self-control, confidence in problem solving and trends-avoid style, ( $p < 0.05$ ). generally speaking training emotional self-regulation techniques was effective on problem-solving ability. in covariance analysis by removing effects of pre-test between experimental and control group, significant difference was observed between the mean of post-test in both groups, and this indicates that significant difference between the mean of post-test in both groups, were merely the result of training self-regulation techniques.

Conclusion: The results of this survey shows that training emotional self-regulation techniques among students of faculty of humanities in yazd university of Science And Art, had a positive effect on problem-solving ability, thus introducing techniques for people in different situations is recommended.

Keywords: emotional self-regulation, problem-solving ability

(4)

#### **Exploring the Vowel Bias in Non-Human Animals.**

IRENE TORRES, JUAN M. TORO, *Universitat Pompeu Fabra*.

Adults rely on consonants to disentangle lexical items during word recognition. However, 5-month-old infants and newborns seem to

focus on vowels. Here we wanted to explore whether non-human animals present a similar vowel bias. To control for the possibility that acoustic salience could play a pivotal role in their preferences, we also ran a second experiment modifying the fundamental frequency and the duration of the vocalic segments. Rats were trained to discriminate between two acoustic CVCV synthesized non-words. Three test trials were run. In each trial we presented a pair of new non-words created from the reinforced training non-word by modifying the edge phonemes (XVCV and CVCX), the inner phonemes (CXCV and CVXV) or the consonants or the vowels (XVXV and CXCX). Our results show that rats focused on the vowels to recognize the reinforced non-word. They responded less after the presentation of test items with modified vowels than after test items with modified consonants. Results were the same for the group with equal acoustic cues for consonants and vowels, and for the group with modified acoustic cues in vowels. Our study shows that rats, as human newborns, present a vowel bias. It also suggests that such preference for vowels is not influenced by the modification of specific acoustic cues, such as the duration and the fundamental frequency of the vowels.

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### Attention and Performance

(5)

#### Eye-movement Orienting and Fixations on Emotional Scenes: Gender Differences.

PATRICIA ÁLVAREZ-PLAZA, *University of La Laguna*,  
ANDRÉS FERNÁNDEZ-MARTÍN, *International University of La Rioja*.

The issue of similarities and differences between men and women in the processing of emotional pictures and visual scenes has been investigated with a variety of paradigms and measures. The stereotyped belief that women are more "emotional" than men, if true, could therefore have important implications for sex differences in adaptive function. With an eyetracking methodology, this study investigated sex differences in attentional capture by emotional visual scenes as a function of scene valence and content (N = 40, age range 20-30). Pairs of emotional (pleasant or unpleasant) and neutral scenes of comparable physical image properties were presented peripherally and then made available to foveal vision. Attentional capture was assessed in two stages: (a) initial orienting and (b) later attentional engagement. The results show that emotional scenes captured attention with respect to the neutral scenes. Furthermore, for pleasant contents, male observers were more likely to orient to and also to engage with opposite-sex and couples erotica, while females were more likely to engage with families/babies and opposite-sex erotica. For unpleasant contents, mutilation scenes were especially attention-capturing for both females and males, while scenes depicting human attack (except it women were attacked) prompted more orienting in males than females. This study shows that attentional processing differences between men and women depend on emotional valence, specific scene content, and type of attentional-capture mechanism.

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(6)

#### Does the List Level Proportion Congruency Effect Change as a Function of SOA When There is an Associative Learning Bias?

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The list level proportion congruency effect (LLPC), which is defined by a smaller Stroop interference in mostly congruent lists compared to mostly incongruent lists, has been acknowledged as an indicator of strategic control of Stroop interference. On the other hand, the item-specific proportion congruency (ISPC) effect, which is demonstrated by a smaller Stroop interference for mostly incongruent items compared to mostly congruent items, has been shown to reflect effects of associative learning processes on Stroop interference. There is a continuing debate on whether LLPC effects are confounded with ISPC effects. The authors previously showed that the ISPC effect interacted with the stimulus onset asynchrony (SOA) between the color and the word dimensions in a Stroop experiment. When the word followed the color with a 200 ms delay, the ISPC effect was observed to be smaller compared to other SOA conditions. In the present study, we investigated whether the LLPC effect interacted with SOA in a similar fashion. The LLPC was manipulated so as to include associative learning biases. The interaction between LLPC and SOA produced a different pattern than the interaction between ISPC and SOA that was observed in previous studies. These results suggest there might be more to the LLPC effect than that is explained by the ISPC effect.

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#### Fearful Body Actions Attract Infants' Attention.

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Although both attention-getting and attention-holding are significant aspects of perception, much of the previous work on attention to emotions in infancy has focused on attention-holding. Moreover, virtually nothing is known about the development of attention to emotions expressed by bodies. We examined whether fearful emotions portrayed by body movements attract infants' attention. Five- and 9-month-olds (n = 24 at each age) completed an attention overlap task in which a checkerboard pattern was displayed in the center of the screen for 3000 ms. After this initial period, the pattern remained on the screen while a peripheral fearful, happy or neutral body movement video appeared on the left or right for 3000 ms. Infants were significantly faster to reach the video when the display portrayed fear (M = 689.57; SE = 30.36) than happy (M = 804.40; SE = 46.01) or neutral emotions (M = 828.17; SE = 49.80). There was no difference in the latency to reach happy versus neutral stimuli. The results suggest that fearful body actions attract infants' attention faster than happy and neutral bodies. This pattern of response to fearful emotions did not differ between 5 and 9 months, suggesting an early development of sensitivity to specific emotions portrayed by bodies. Early in life, infants systematically and appropriately respond to socially significant information such as emotion in bodies.

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### Assessing the Role of Cognitive Domain in Monitoring Processes: An Event-Related Potential Study.

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While it is well-known that monitoring the environment for the occurrence of relevant events represents a key executive function, it is still unclear whether it is mediated by domain-general or domain-dependent mechanisms. Here we investigated this issue by combining event-related potentials (ERPs) with a behavioral paradigm in which monitoring (non-monitoring vs. monitoring) and domain (spatial vs. verbal) were orthogonally manipulated within the same individuals. On non-monitoring blocks, participants categorized 3-dimensional visually presented words following either a spatial or verbal task rule. On monitoring blocks, they additionally checked whether the word represented a specific spatial configuration or whether it contained a certain consonant. A significant monitoring cost, with slower responses for monitoring as compared to non-monitoring trials, was observed for both domains. The ERP results also showed that monitoring did not interact with domain, thus suggesting the involvement of common underlying mechanisms. Specifically, monitoring acted on lower-level perceptual processes (as expressed by an enhanced visual N1 wave and a sustained posterior negativity for monitoring trials) and on higher-level cognitive processes (involving larger positive modulations on monitoring trials over frontal and parietal scalp regions). The source reconstruction analysis of the ERP data further confirmed that monitoring was associated with increased activity in visual areas and in right prefrontal and parietal regions (i.e., superior and inferior frontal gyri and posterior parietal cortex), which have been reported in previous studies targeting spatial and temporal monitoring. Our findings thus extend this research by supporting the domain-general nature of monitoring in the spatial and verbal domains.

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### Divided Attention in Multitasking with Mobile Devices.

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Screen displays today seem to be ubiquitous, varied in appearance, and deployed in many situations. As a result they potentially affect people's abilities to attend to and perform everyday tasks. In applied domains, screen displays affect human performance at work, the ability to attend to multiple stimuli optimally, and distractedness while operating vehicles. Two ways in which displays vary are their size and mobility. Previous research has shown that people are increasingly using multiple displays, including mobile devices, simultaneously and that this split in attention has detrimental effects on goal-directed behavior. Other research suggests that a larger display improves performance over a smaller display when showing textual information. More studies show that holding a display will alter attention, which is unique to mobile devices. In order to address these questions participants were asked to perform a task with a mobile device and a stationary device. On a mobile device (foreground) of either 4.8 or 10.1 inches, participants maintained a jittering ball within a circle. On a 19in. computer display participants vocally responded to a choice task (background

task). Data analysis suggests that those using a smaller foreground device achieved higher performance on the background task than those using a larger device, while having similar performance in the foreground task. Future studies are needed to determine the mechanism of this difference in performance.

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### Inhibition after Attentional Capture Depends upon Target Uncertainty.

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The recovery account states that exogenous visual attention is allocated in a stimulus-driven manner, and then it is rapidly disengaged from the attended location, thereby leaving no sign of attentional capture behind. The present study was conducted to measure a signature of recovery, under an experimental setting designed to encourage capture by a task-irrelevant cue. To this end, a spatial cueing paradigm was used with letters added inside four placeholders of the cue display in which one of the placeholders was cued by color. Participants were to respond to the target which was either compatible or incompatible with the cued stimulus. In Experiment 1, participants performed a go/nogo task in which the target was printed in one of two pre-defined go and one nogo colors. With longer response times found with the nogo-color cue than the go-color cue, only trials with the go-color cues yielded a significant compatibility effect and a significant cueing effect. In Experiment 2, participants responded to a target presented in a pre-defined color, while ignoring a concurrently presented distractor. The pattern of the results was identical to Experiment 1 with one exception that overall response times to trials with the target-color cue was significantly longer than trials with the distractor-colored cue. In conclusion, when the target-defining color was not known in advance, task-irrelevant cue showed a sign of inhibition after attentional capture. However, when the target-defining feature was fixed, neither the sign of capture nor recovery after inhibition was observed.

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### Executive Control Modulations of Conscious Perception.

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Introduction: The relation between attention and consciousness is still controversial. Previous studies have demonstrated that some attention networks (alerting and exogenous orienting) are important pre-requisites of conscious perception (Kusnir et al., 2011; Chica et al., 2010; 2011). To date, the relationship between executive control (Petersen & Posner theory's third network of attention) and conscious perception has been suggested (Mack & Rock, 1998; Shapiro, Raymond & Arnell, 1997; Fougny & Marois, 2007), but not directly manipulated. Material and methods: We combined a standard Stroop task at fixation and a Gabor detection task in the periphery. The Gabor was presented at the threshold for conscious perception, and could appear either simultaneously to the Stroop stimulus or after a short delay. We manipulated the proportion of congruent and incongruent trials in the Stroop task,

in order to independently observe the effect of two different control mechanisms on conscious perception: reactive and proactive control (Braver, 2012). Results and Conclusions: In contexts where reactive control was more likely to be recruited (high percentage of congruent trials), decision criterion to detect the near-threshold stimulus was stricter after incongruent than congruent trials. The activation of proactive control did not modulate conscious perception. Moreover, error commission in the Stroop task, which could also recruit reactive control mechanisms, had an effect on both perceptual sensitivity and response criterion to detect the Gabor. Our data supports the idea that both executive attention and conscious perception mechanisms of decision making would be implemented in partially overlapping brain regions.

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### Perceptual Composition and Scene Identification in Early Visual Processing: ERP Results.

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The identification of natural scenes relies on the hierarchical analysis of the visual input, and a number of studies focused on the neural processes which are involved in the analysis of the sensory input. Here we report the results from two separate studies, in which we examined the processing of natural scenes and used Event-Related Potentials (ERPs) to track the early stages of visual processing. Participants viewed degraded versions of natural scenes (high-pass or low-pass filtered, or phase scrambled) and responded according to their identification of the scene. In both studies a P2 component was observed over occipital areas, and was modulated in amplitude both by picture degradation and by scene identification. More specifically, the amplitude of this component varied with the average spectral power, similarly for high-passed and low-passed scenes, and more positive amplitudes were observed as scenes increased in spectral power (Study 1). Once the Fourier spectral power was equated across pictures and differences in scene composition were taken into account (Study 2), a significantly less positive amplitude of the P2 was observed for less degraded scenes compared to more degraded ones; the positivity of the P2 component was further reduced when pictures were correctly categorized, compared to when categorization was incorrect. Taken together these studies suggest that the visual processing stage reflected by the P2 is bound both to scene composition and to scene understanding, and may reflect the analysis of scene features which are diagnostic for scene understanding.

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### Effect of Acute Exercise on Vigilance: Influence of Exercise Intensity and Duration.

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We investigated vigilance during acute exercise. To this end, we measured reaction time (RT) in the Psychomotor Vigilance Task (PVT) as a function of exercise intensity. In Experiments 1 and 2, participants cycled at four different intensities [40%, 60%, 80%, and 100% of the Ventilatory Threshold (VT)]. In Experiment 1, the intensity increased as a function of time. The results did not

reveal any effect of exercise intensity. Given that participants' RT increased linearly with time-on-task (the typical vigilance decrement), we hypothesized that any effect of exercise intensity could have been masked by the passage of time. Therefore, in Experiment 2, participants cycled at the four intensities in different (counterbalanced) sessions. The results showed a RT speeding from the 40% to the 80% intensity condition, and a RT slowing at the 100% intensity. Experiment 3 was designed to investigate the time course of the effect of a 45' bout of exercise at the 75% of the VT on vigilance performance. The participants performed the PVT in two different sessions: a light-moderate intensity condition (75% of their VT) and a control condition (exercising at essentially no load). The results showed that participants were overall faster in the light-moderate intensity exercise condition than in the control condition. Taken together, our results suggest that vigilance exhibits a curvilinear response to exercise intensity with an "optimal" point at 60-80% of VT, and that the effect of the "optimal" intensity remains constant over time, at least for 45'.

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### Investigating the Boundary Conditions of Efficient Dual-Task Performance: Testing the Distinct Modality-Based Systems Hypothesis.

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Previous examples of dramatically reduced dual-task costs involved tasks with highly-compatible S-R pairs (e.g., Greenwald, 2003). Recent findings show that two tasks need not have high element-level compatibility to reduce costs as long as the two tasks engage distinct modality-based systems (Halvorson & Hazeltine, 2015). The present studies tested the boundary conditions of this hypothesis. In the first experiment we measured dual-task costs with non-standard modality pairings (visual-vocal and auditory-manual). The second experiment paired an auditory-vocal (AV) task with non-word stimuli and arbitrary mappings with a spatially compatible visual-manual (VM) task. Despite increasing overall task difficulty, both experiments showed minimal dual-task costs for roughly half the participants (the other half showed large costs). These findings support the distinct modality hypothesis, and they are consistent with previous findings of individual differences in participants' willingness to perform two tasks simultaneously (see e.g., Schumacher et al., 2001). In a third experiment, we paired an AV and VM task with mixed-item task sets (half the S-R pairs engaged distinct modality-based systems and the other half did not). Large costs were observed with the mixed-item task sets regardless of which S-R pairs were presented on a given trial. This indicates that the relationship between all elements of the S-R pairs for both tasks is critical for predicting the magnitude of the costs. Cumulatively, the findings illuminate some boundary conditions of the distinct modality-based systems hypothesis including individual differences and the importance of the relationship among even the inactive items in the task sets.

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### How Multiple-Choice Options Influence Choice Blindness.

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The choice blindness phenomenon, or the inability to detect false feedback about personal preference selection from a pair of alternatives, has now been well established across different stimuli and conditions. The choice blindness method employs binary decision tasks with preferences for faces (Johansson, Hall & Sikström, 2008; Johansson, Hall, Sikström, Tärning & Lind, 2006), taste (Hall, Johansson, Tärning, Sikström & Deutgen, 2010), political voting (Hall, Strandberg, Pärnamets, Lind, Tärning & Johansson, 2013), moral opinions (Hall, Johansson & Strandberg, 2012), and personal finance (McLaughlin & Somerville, 2013). Accordingly, in one experiment, we developed and employed ternary choice method in order to understand the influence of multiple options (varying in similarity and attractiveness) on choice blindness and justification of preferences. Participants saw three female faces on the screen, and were required to select the one they preferred. They were then asked to indicate how confident they are in their choice and to provide an explanation behind that choice. The research provides insight into the psychological mechanism underlying the choice blindness phenomenon by using multi attribute decision-making scenarios (Huber, Payne & Puto, 1982; Ariely, 2008) and varying the similarity and attractiveness of the choice options presented.

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### Neurophysiological Evidence of Error Processing and Behavioural Adjustment in the “Congruency One-Back Task”.

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Error monitoring is a key function in adaptive behaviour. The error related negativity (Ne/ERN) is an event-related potential (ERP) that arises after erroneous responses. The ERN is usually followed by a positive ERP component which is known as the Pe. Both of these neurophysiological markers of error monitoring have been used to study neuropsychiatric conditions such as anxiety disorders, addiction, and ADHD. However, the relatively low proportion of error trials in tasks that are usually used for investigating error-related components has its implications for the psychometric properties of the ERN and Pe. Therefore, the reliability of the measurement of these components may be at stake in situations when testing vulnerable participants such as psychiatric patients. In such situations, a task that produces reliable assessments of error-related components in shorter sessions is necessary. Here, we propose a new “Congruent One-Back Task” (COBT), and assess whether this task is suitable for error-monitoring research. Participants were presented with arrows pointing either left or right, and had to respond if each arrow matched the previous arrow in the sequence or not. Behavioural results indicated high reliability in response times, and that the number of error trials was adequate for ERP analysis. The ERN and Pe showed the expected topographical

features which are usually found in these components. Moreover, we found a positive correlation between the behavioural marker for error processing – the posterror slowing effect – and the amplitude of the ERN, suggesting a link between error detection and behavioural adjustment.

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### Category-Response (not Stimulus-Response) Associations Transfer to Novel Contexts.

CAI LONGMAN, FRASER MILTON, FREDERICK VERBRUGGEN, *University of Exeter*. Although participants in cognitive control experiments are often instructed to classify stimuli according to categories (e.g., digits as odd/even, letters as vowel/consonant, objects as living/man-made), learning in these experiments is often interpreted in terms of stimulus-response (S-R) bindings with little attention being paid to the importance of category-response (C-R) bindings. In a new Rapid Instructed Task Learning paradigm designed to investigate the early stages of category learning and transfer of skill elements to novel contexts, participants were required to classify novel stimuli according to the two category prototypes presented during the instruction phase prior to each block. Each block consisted of a ‘training’ phase and a ‘test’ phase. In some blocks the stimuli, categories or responses (or any combination thereof) used in the test phase could be novel or repeated from the training phase. Learning was assessed by comparing performance at test with performance during training. Participants did not appear to learn anything useful about the S-R associations, but C-R associations were easily generalized to novel stimuli. Thus, under conditions that strongly encouraged participants to rapidly form novel category structures, S-R associations were almost redundant whilst C-R associations strongly modulated performance. This highlights the importance of a much neglected, yet critical, aspect of human cognition, which might help resolve a number of existing disputes in the cognitive control literature.

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### Change Deafness and Expertise in Sports Radio Broadcasts.

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Change deafness occurs when seemingly obvious changes in an auditory scene go unnoticed by a listener. Recent work shows that despite typical language familiarity effects, change deafness for speech is worse in your native language than in a language that you do not understand (Neuhoff et al., 2014). Expertise in a language allows attention to be allocated to the lexical/semantic aspect of the signal presumably leaving fewer resources to be allocated toward detecting a change in talker. Here we examined the effects of expertise in American football on change deafness in a commonly encountered real world setting. We presented experts and novices with a 30 s excerpt of the home team broadcast of two sportscasters announcing an American football game on the radio. During a penalty announcement by the referee, we switched to the away team broadcast which featured two different sportscasters



announcing the continuation of the same game for another 30 s. We hypothesized that participants who knew the game well would allocate attention to the events happening on the field and be less likely to detect the change in broadcasters. Novices on the other hand, would be more likely to focus on the indexical characteristics of the broadcasters and be more likely to detect the change. The results are discussed in terms of expertise and the allocation of attention to indexical characteristics in real world environments.  
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### Evidence for Context Driven Updating of Task-Set Representations in Procedural Working Memory: The Informed Fadeout Effect.

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A few explanations have been suggested to account for preparatory mechanisms underlying the ability to efficiently update working memory content. This study was meant to explore *procedural* working memory updating at the level of the plausible task-sets held for upcoming performance through context updating – a rapid online change in control demands, tested employing the task-switching paradigm. Previous research suggested there is a “fadeout effect” when moving from a task-switching to single-task performance (Mayr & Liebscher, 2001), indicating improvement in performance when one task is declared to be no-longer relevant, yet this effect could reflect passive learning rather than intentional control. The current study presents the “informed fadeout paradigm”, in which participants are sometimes informed and sometimes uninformed regarding a task cancellation for a certain number of trials. A series of experiments (N=115) showed the “informed fadeout effect”, which reflects the fact that participants performed better in the informed (relative to uninformed) condition, but only after one trial had been performed. Thus, the process is not fully proactive upon instruction. In addition, this trend was more prominent at the end of the experimental block, and providing more time to prepare for the context update did not alter the effect. These results can be considered as supporting a “retroactive adjustment” intentional control, which maximizes performance as a function of the current system’s state.

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### Acute Stress Increases the Preference for Delayed over More Immediate Rewards Independent of Their Relative Merit.

FRANZISKA PLESSOW, *Technische Universität Dresden/Harvard Medical School*, SUSANN SCHADE, *Technische Universität Dresden*, RICO FISCHER, *Technische Universität Dresden/Ernst Moritz Arndt University of Greifswald*, STEFAN SCHERBAUM, MAJA DSHEMUCHADSE, CLEMENS KIRSCHBAUM, *Technische Universität Dresden*. Stress has frequently been argued to impair prefrontal cortex-dependent functions including cognitive control. When deciding between more immediate or delayed rewards, decreased cognitive control under stress would translate into more frequent choices of the more immediate reward (increased temporal discounting). Recent evidence however suggests that acute stress can also trigger an

increase in cognitive control, stabilizing behavior and reducing situational uncertainty. These results would predict an increased preference of delayed over more immediate rewards (reduced temporal discounting). To test this, 48 participants were randomly assigned to a stress or control group. The stress group was exposed to a well-established psychosocial stress-induction protocol (Trier Social Stress Test), while controls underwent a standardized control intervention. Before and after their respective intervention, all participants performed a gamified temporal discounting paradigm, choosing between two rewards of varying size and distance by navigating an agent through a virtual environment. Based on an individual’s indifference points, the  $k$  parameter was calculated as measure of temporal discounting. Successful stress induction, as indicated by increased salivary alpha-amylase and cortisol levels, decreased the  $k$  parameter compared to baseline, while no changes were observed in controls. This finding indicates reduced temporal discounting under acute stress. Additional analyses revealed that stress did not improve the quality of decision-making but induced an unspecific bias toward delayed options.

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### Introspective Access to an Implicit Shift of Attention.

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Literature in metacognition has systematically rejected the possibility of introspective access to cognitive processes preceding a decision; which derives from the difficulty of experimentally manipulating cognitive processes. The aim here was to expand the range of introspective knowledge by asking whether participants could introspectively describe the attentional shifts (i.e., the cognitive process) in two types of visual searches: feature and conjunction searches. Both overt (Experiment 1) and covert attention shift tasks (Experiment 2) were conducted. Immediately afterwards, participants were instructed to give, on a trial-by-trial basis, an estimate of the *number of elements scanned before the perceptual decision*. Additionally, in Experiment 3, the focus of attention was controlled with an anticipatory and distractive pre-conscious cue presented before the visual search task. Afterwards, it was evaluated whether introspection was capable of accessing this alteration. Results provided evidence of awareness of the processing difference: In Experiment 1, participants were able to globally differentiate the type of search; however, introspection was 65% mediated by eye movements. In Experiment 2, eye movements were controlled and the same introspective pattern was found, suggesting that there is no reason to conclude that introspection uses eye movements to infer the number of items scanned. In Experiment 3, results confirmed that introspection has access to an implicit shift of attention. All of the experiments converged on three ideas: 1) introspection is capable of accessing cognitive processes; 2) introspection is permeable to different sources of information; 3) the focus of introspection can be experimentally controlled during a cognitive task. Email: Gabriel Reyes, [gureyes@uc.cl](mailto:gureyes@uc.cl)





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### The Effect of Gaze Direction on Time Estimation.

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Direct gaze conveys valuable information about the intentions of conspecifics regarding communication and social interaction. Consequently, direct gaze has been shown to engage attention more efficiently compared to averted gaze. Moreover, this attentional effect is reported to be rather short-lived, manifesting at short stimulus durations while subsiding or disappearing at longer ones. The attentional-gate model (AGM) of timing predicts that attentional engagement in non-temporal information processing will lead to interval underestimation. We, thus, hypothesized that direct gaze would lead to greater interval underestimation as compared to averted gaze, an effect that may be observed only for short time-intervals. We used a reproduction task where participants were presented with one of three images (a woman's face displaying a neutral expression with direct or averted gaze) for a duration of 1200, 2400, 3600, or 4200ms. Subsequently, participants were instructed to reproduce the presented interval and to press 'enter' when they deemed that the same amount of time had elapsed as the time-interval that the image had appeared on screen. As hypothesized, interval underestimation was greater for the direct gaze as compared to the averted gaze in the 1200 and 2400ms conditions, whereas for the longer intervals tested (3600, 4200ms) the effect disappeared. Our findings demonstrate, for the first time, how direct gaze can affect one's temporal percept and confirm the central role of attention in time estimation, as proposed by the AGM. Furthermore, this is the first study showing how components of social interaction such as gaze can modulate one's temporal experience.

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### Can Reward Counteract the Effects of Emotional Distracters?

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Interference effects in the presence of task-irrelevant emotional pictures have been observed during a variety of visual tasks, suggesting that emotional stimuli capture and divert attentional resources away from the main task. We have recently reported that performance-based monetary rewards reduce interference effect of negative distracters during perception. However, how reward interacts with both positive and negative distracters remains largely unknown. To fill in this gap, the present study investigated how reward influences behavior during a perceptual task in which participants discriminated the orientation of peripheral bars while ignoring a centrally presented positive, negative or neutral stimulus. It is possible that reward may counteract the deleterious effects of both positive and negative distracters, suggesting a mechanism based on a general salience effect. On the other hand, if reward affects only the distracter of opposite valence (i.e. negative), then reward may work as a specific valence mechanism. We observed that reward strongly counteracted the effect of potent negative distracters during a visual discrimination task, but with minimal impact on the effects of positive distracters. Thus, reward acts as

a valence-specific mechanism that strongly reduces the deleterious impact of high arousing negative stimuli compared to the effect on pleasant, arousing scenes.

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### Cognitive Control across Cognitive and Social Conflicts.

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Cognitive control has been extensively argued to be domain-specific, suggesting that control readiness processes are limited across different types of conflicts (e.g., Egner, 2008). Here, we aim to explore the circumstances under which a domain-general account of cognitive control can be favoured over the current theory. We replicated one of the few experiments that reported sequential congruency effect across two different types of conflict: a cognitive conflict triggered by a classical flanker task and a social conflict based on gender stereotype (Kleiman, Hassin & Trope, 2013). We observed that participants took benefit from control implementation in the classical flanker task to reduce the interference in a non-related social conflict. Further, in order to increase the interference effect, we manipulated the location of the stimuli and presented it randomly either above or below fixation. This manipulation allowed us to observe that interference effects were highly dependent on the context. Indeed, we found that in the social task, interference was significant only after a congruent cognitive trial presented in the same location. In other words, rather than social conflict being reduced after experiencing cognitive conflict, our pattern of results suggests that the expression of the social interference is only observed after experiencing a cognitive congruent situation. We discuss the role of different contextual parameters in sequential congruency effect and the implications for control implementation.

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### Complex Cognition

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### The Relationship between Metacognitive Components and Dysfunctional Attitudes in Opium Addicts in Kerman, Iran.

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**Introduction:** The term metacognition literally means cognition about cognition, or more informally, thinking about thinking. The aim of present study was to evaluate the relationship between metacognition and inefficient attitudes in opium addicts. Inefficient attitudes refer to those attitudes and beliefs that predispose the person to depression or in general to psychological distress.

**Methods and Materials:** The sample of present study included all addicts referring to a referral center for treatment of addiction in Kerman, Iran. 300 individuals selected using random cluster sampling. They attempted to complete the questionnaire of metacognition and inefficient attitudes scale.

**Results:** The results of the Pearson correlation coefficient indicated that metacognition and its components have a significant and positive relationship with inefficient attitudes ( $p < 0.05$ ,  $r = 0.38$ ). Also, the results of multiple regression analysis suggested that

the components of negative beliefs predict inefficient attitudes compared to uncontrollability, danger, and belief to control thoughts, respectively ( $p < 0.05$ ,  $r^2 = 0.45$ ,  $0.39$ ). These two factors showed the most significant and positive relationship with components of affectability, vulnerability, and perfectionism in scale of inefficient attitudes. The components of positive belief regarding worry, beliefs related to cognitive confidence, and beliefs concerning cognitive self-awareness, didn't indicate any significant contribution in predicting the variable of measure and its components.

Conclusion: The results of present study suggest that disorder in higher levels of cognition increases the inefficient attitudes of opium addicts. Also patients with substance abuse impairment of metacognition, schema, dysfunctional attitudes, and cognitive impairment are inclined to suffer more.

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### If It's Difficult To Pronounce, It Might Not Be Risky: The Effect of Fluency on Judgment of Risk Does Not Generalize To New Stimuli.

ŠTĚPÁN BAHNÍK, *University of Würzburg*, MAREK VRANKA, *Charles University in Prague*.

Processing fluency, a metacognitive feeling of ease of processing, is used as a basis for various types of judgment. For example, previous research has shown that people judge food additives with more difficult-to-pronounce (i.e., disfluent) names as more harmful. In the present study, we originally explored the possibility that the association between processing disfluency and harmfulness might be in the opposite direction for some categories of objects. While we initially found some support for the hypothesis, further studies indicated that the studied effect of processing fluency is largely dependent on the stimuli used. In the last two studies, we showed that even though the original fluency-safety association is replicable with the stimuli used in the previous research, the effect disappears for newly constructed stimuli. The results cast doubt on generalizability of the association of fluency and safety and underscore importance of treating stimuli as a random factor.

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### The Presence of Side Effects Reduces the Causality Bias Associated to Bogus Treatments.

MARCOS DÍAZ-LAGO, FERNANDO BLANCO, HELENA MATUTE, *Universidad de Deusto*.

Bogus treatments have usually no side-effects, which impels people to use them frequently, even if they are ineffective. According to a previous study, this frequent use of the treatment results in the development of an illusory belief that the treatment actually causes the healing (i.e., illusion of causality). Thus, when a bogus treatment has side-effects and it is less frequently used, people realize that it is not effective. The aim of our study is to investigate if this influence of the treatment's side-effects on the illusory perception of causality still appears when the frequency of use of the treatment is controlled for. Fifty-four volunteers participated in the study. They performed a standard contingency learning task, in which they were asked to imagine being a medical doctor and to observe a number of records of fictitious patients affected by a disease which might be cured by a new and experimental medicine. Participants were divided into two experimental groups, one of them saw a medicine with

side-effects, and the other one saw a medicine with no side-effects. In both groups, the objective contingency between the medicine and healing was zero. Once participants had seen all patients, they answered a causality judgment. Our results show that participants who saw a medicine with side-effects perceived the medicine as less effective, being more accurate in the detection of the real contingency between the medicine and the healing of the patients, even if they saw exactly the same information as in the other group. Email: Marcos Díaz-Lago, [marcos.diaz@deusto.es](mailto:marcos.diaz@deusto.es)

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### Measuring Graph Literacy without a Test: A Brief Subjective Assessment in Diverse Samples and Cultures.

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Visual aids can confer important benefits when communicating health risks and tend to be most helpful for people who have some basic understanding of graphs (i.e., graph literacy). Tests of objective graph literacy can effectively identify individuals with limited skills, highlighting vulnerabilities and facilitating custom-tailored risk communication. However, these tests can be time consuming and may evoke negative reactions (e.g., anxiety). The aim of our research was evaluating a brief and easy-to-use assessment of subjective graph literacy (self-reported ability to process and use graphically presented information), and comparing it with the leading objective graph literacy scale in diverse samples. We conducted a focus group and four studies for test development and initial validation (Study 1), reliability evaluation (Study 2), and predictive validity evaluation (Studies 3 and 4). Participants in our studies were demographically diverse residents of the United States ( $n=470$ ), young adults ( $n=116$ ) and patients ( $n=175$ ) from Spain, and surgeons from 48 countries ( $n=175$ ). We measured the psychometric properties of the scale (basic properties; reliability; convergent, predictive, and discriminant validity). In about one minute, the subjective graph literacy scale provides a reliable, robust, and valid assessment of graph literacy and risk communication preferences, and evokes fewer negative reactions than the objective graph literacy scale. The subjective graph literacy scale can be suitable for use in clinical research and may be useful as a communication aid in practice. Theoretical mechanisms involved in subjective graph literacy, emerging applications, and open questions will be discussed.

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### Illusory Transparency in Schoolchildren.

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We tested how schoolchildren from 2<sup>nd</sup> to 6<sup>th</sup> grades keep track of their knowledge of different characters in a story. We also tested whether their own privileged knowledge is transparent to other characters (illusory transparency). In a previous study, adults erroneously attributed knowledge of a critical piece of information possessed by only one character to another. The first character sent a message to the second one, without the critical information. Participants misattributed knowledge of the critical message only



when the two characters had met previously but not when they had not met, e.g. an accidental reader read the message. We adapted Keysar's (1994) task, in which a sarcastic interpretation of the message by the addressee indicated the illusory transparency effect. The presence of an accidental reader was manipulated. Results showed that children, unlike adults, were not sensitive to the relationship between characters (no significant effect of the accidental reader). Also, against other egocentric biases, the illusory transparency effect increased during the school years. The results are discussed in terms of egocentrism, pragmatics and mental contamination.

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### Conflict Detection in Insight Problem Solving.

SERGEI KOROVKIN, ANNA SAVINOVA, *Yaroslavl State University.*

A phenomenon of instantaneous illumination during creative problem solving, which is known as insight, probably depends on specific psychological mechanisms. These mechanisms can be found via comparison of dynamics in insight and noninsight (algorithmized) problem solving. Solving processes of such types of problems require different executive functions. We propose that processes of error and conflict detection play specific role in insight problem solving. In our study, we used a double-task technique to examine a dynamics of time reaction of a probe-task (secondary task) during problem solving (primary task). Time reaction in the probe task reflects dynamics of executive functions. In the experiment (32 participants, 317 solved problems) we used two types of problems (insight and algorithmized) and two types of probe-tasks (conflict/noncongruent and nonconflict/congruent). ANOVA showed significant differences between reaction time dynamics of probe tasks in insight and algorithmized problem solving. In this experiment, we found that dynamics in insight problem solving is different in different probe tasks. There are significant dynamics during conflict/noncongruent probe-task in insight problem solving, whereas there are no significant dynamics during nonconflict/congruent probe-task. These findings indicate that conflict detection can be considered as a specific executive function at some stages of insight problem solving in contrast to sequential execution.

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### The Role of Motor Regions in Representing Engineering Concepts.

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According to the sensorimotor hypothesis of semantic knowledge, physical experience shapes conceptual representations. Consistent with this hypothesis, neuroimaging research demonstrates that motor regions support knowledge about tool use and motor actions. However, few studies have examined whether abstract concepts that may also be learned through experience are also rooted in the sensorimotor systems of the brain. Here, we focus on the mechanical engineering concept of static equilibrium. We aim to determine whether advanced understanding learned, in part, through physical laboratory experience leads to a neural representation of this concept in motor regions. In order to test this hypothesis,

students with no prior engineering training, and those who have completed one or more college lab-based courses on structural engineering completed an fMRI task involving mechanical analysis of structures. The task included a carefully chosen set of 24 photographs of real-world structures (e.g., streetlamp) each with one component highlighted (e.g., vertical column). Specifically, some pairs of images were matched on visual similarity (VS) but mismatched on mechanical similarity (MS) whereas other pairs of items were matched on MS and mismatched on VS. This design allowed for the dissociation of surface details (VS) from deeper understanding of static equilibrium (MS). Results revealed that VS correlated with activity in early visual cortex both for novices and for engineering students, whereas MS correlated with activity in motor regions - but only for the engineering students. These results support the hypothesis that some abstract concepts are also rooted in sensorimotor experience.

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### Seeing Soft Objects Enhances Deontological Moral Judgment.

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Studies of embodied cognition suggest that one's bodily experiences, such as being held by his/her mother and sensing softness, are grounds of social relationships. Cushman et al. (2006) showed that a physical contact affected people's moral dilemma judgment. They asked participants to judge whether harming or killing someone is permissible in order to save others. As a result, participants were less permissible to sacrifice an individual when scenario contained a physical contact (e.g., pushing a man) than no physical contact (e.g., pushing a button). Majima and Nakamura (2015) revealed that touching soft or hard object alters participants' moral dilemma judgment. These studies imply that haptic sensation affects people's moral decision making. Present study tested whether seeing soft or hard object affected moral dilemma judgment. We hypothesized that seeing soft objects makes the participants to feel as if they have physical contact and thus enhances deontological moral judgment. In the on-line experiment, 157 Japanese participants were presented images of soft or hard objects, and then completed eight high-conflict moral dilemma tasks. The results showed that participants who saw soft objects were less permissible to sacrifice an individual. The results indicated multimodal nature of embodied cognition in moral judgment.

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### Psychics, Aliens, and Bias: The Relationship between Anomalistic Beliefs, the Bias against Disconfirming Evidence, and the Jumping to Conclusions Bias.

TOBY PRIKE, MICHELLE M. ARNOLD, PAUL WILLIAMSON, *Flinders University.* Previous research has found that people who hold anomalistic (e.g., paranormal) beliefs may be more prone to some cognitive biases than non-believers. The current studies investigated two cognitive biases that had not yet been looked at in relation to anomalistic beliefs; the bias against disconfirming evidence and the jumping to conclusions bias. Both of these biases

have been investigated in the area of delusions, and this research has shown that people who are delusional or delusion prone typically exhibit a stronger bias against disconfirming evidence and are quicker to jump to conclusions. The current studies extended this research into the area of anomalous beliefs, which are beliefs that, although contradicting our current understanding of reality (e.g., psychics, ghosts, contact from aliens), are still held by large proportions of the general population. The results showed a positive relationship between anomalous belief and both bias against disconfirming evidence and jumping to conclusions bias. Additionally, the results also demonstrated that, when using the factors that make up the newly developed Anomalous Belief Scale (ABS; Prike, Arnold, & Williamson, 2015), the relationships between anomalous belief, the bias against disconfirming evidence, and the jumping to conclusions bias varied across the different factors. For example, performance depended, to at least some degree, on whether a person believed in psychics versus aliens. These results suggest that the relationship between anomalous beliefs and cognitive biases depends on the type of anomalous belief held.

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### The Development of Thinking with Semifactual Conditionals in Children of School Age.

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Children do not reach a complete understanding of counterfactual expressions until around the end of primary school. Their difficulty could be related to comprehension (the required representation) and/or to the metalogic knowledge of necessity and sufficiency. We tested these two possibilities with children of 7 to 13 years, using semifactual expressions such as “even if John had poured water into the bucket, it would have been empty”. That kind of semifactual conditional involves considering not only how things are (John did not pour water and it was empty) but also how things could have been (John poured water and it was empty). In addition, semifactuals provide a specific relation of necessity and sufficiency: the conclusion is true regardless of the antecedent. Children were shown different stories with pictures of characters and actions, such as a man taking a bucket with a big hole in the bottom. Then a message was given: “even if the man had poured water into the bucket...? They had to answer two questions of the following kind: 1) would the bucket have been full or empty at the end? 2) did the man pour water into the bucket? Results showed that young children represent the presupposed and the conjectured situations but only older children grasp not only this epistemic difference but also the absence of necessity for the consequent that characterises semifactual expressions.

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### Effects of Real-World Social Group Status on Incidental Learning of Trust.

JAMES W A STRACHAN, STEVEN P TIPPER, *University of York*.

People can use their eyes to direct others' attention towards objects and features in their environment. A person who consistently looks away from targets is later judged to be less trustworthy than one that consistently looks towards targets, even when the person is a background distractor that viewers are instructed to ignore. This has been used in previous research to experimentally manipulate the trustworthiness of gaze-cueing faces. However, to date, evidence remains unclear as to how the identity of a cueing face may affect how we interpret trustworthiness from gaze cues. Social psychology has long known that we treat people differently on the basis of social groups, and to date, no studies have investigated whether real-world social groups can affect the incidental learning of trust from gaze cues. As in-group members are typically favoured over out-group members, one might expect that invalid in-group faces would be more resilient to devaluation than out-group faces. Alternatively, in-group members are treated as more heterogeneous individuals than are out-group members, and in-group transgressors can sometimes be punished more harshly than out-group transgressors, so one might expect that this would lead to stricter penalties applied to invalid in-group identities. We explore this by using the real-world social category of race, where participants see faces of both their own and another race, half of which provide valid cues and half invalid. We provide the first investigation into whether these real-world differences in the face identities change how participants learn about trust from patterns of gaze behaviour.

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### Semisupervised Category Learning Enhances the Development of Automaticity.

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In human category learning, learning is studied in a supervised, an unsupervised or a semisupervised way. The scarce human semisupervised category learning studies all focus on the development of the accuracy early in learning in comparison to supervised learning. However, the impact of semisupervised category learning later in the learning process, when automaticity develops, is unknown. Here, the results of the first experiment studying the evolution of reaction time during semisupervised learning are reported. Participants (N=34) were trained on the information-integration category structure for two days. Afterwards, half of the participants learned in a supervised way; the other half in a semisupervised way during two succeeding days. Both groups of participants received an equal amount of feedback trials. Finally, all participants took part in a test day where they were asked to respond as quickly as possible. Repeated Measures showed that on the test day the mean reaction times in the semisupervised group were significantly faster than in the supervised group. This difference was not found on day 2. This implies that the no-feedback trials in the semisupervised condition facilitated automaticity. These results confirm the SPEED-model by Ashby et al. (2007).

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### EEG Correlates of Executive Functions in Insight Problem Solving.

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Executive control suppression is often considered one of the basic mechanisms of insight problem solving. A combination of behavioral experiment and psycho-physiological parameters tracking is traditionally used to test this matter. However such studies often have methodological issues related to stimuli material diversity: authors use various samples of insight and analytical problems, questioning the influence of the problem specifics itself. Other authors distinguish problems based on their subjective "insightfulness" of the solution, which lacks objectiveness. In comparison, we use mental set paradigm, which allows one exact problem to be solved either in insight or regular problem solving conditions.

Modified Luchins problems are used during the experiment. These problems are considered insightful in mental set condition. Removing the set rule learning trials leads to regular problem solving instead. Mean frequency of alpha-waves in prefrontal cortex (Fp1, Fp2, F7, F3, Fz, F4, F8 electrodes) in comparison to similar parameters in post-central cortex (C3, Cz, C4, P3, Pz, P4, O1, Oz, O2) is used as a dependent variable that represents the activation of executive control.

Analysis showed significantly lower alpha-wave frequency in prefrontal cortex during insight problem solving (mental set condition) compared to non-set condition ( $F(2, 47)=3.48, p=.04, \eta=.13$ ) while there was no significant difference in postcentral cortex activation ( $F(2, 50)=.33, p=.72, \eta=0.01$ ). The results suggest lesser influence of executive control functions in insight problem solving as well as the possibility of using Luchins problems for insight problem solving investigation.

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### Domain-Specific Cognition

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### Does Slower Walking Speed Reduce Cognitive Load While Navigating?

ERICA M. BARHORST, KRISTINA M. RAND, WILLIAM B. THOMPSON, SARAH H. CREEM-REGEHR, *University of Utah.*

Research suggests that spatial learning while navigating with severely degraded vision (reduced acuity and contrast sensitivity) demands the use of limited cognitive resources (Rand, Creem-Regehr, & Thompson, 2015). A series of studies using the same paradigm suggests that severely restricted peripheral field shows a similar effect. In the current project, we examined how fast and slow walking speeds during navigation with severe visual impairment influence spatial memory. In Study 1, participants walked on novel real-world paths wearing goggles that restricted the field-of-view (FOV) to 10° and then pointed to remembered target locations using a verbal reporting measure. Participants completed a reaction time task throughout the experiment to measure cognitive load. Participants walked the first half of the paths with a natural slower walking speed of their choosing (they received no instruction) and the second half of the paths at a faster pace. Preliminary results show that walking at a faster pace relates to slower reaction

times (indicating greater cognitive load). In Study 2, participants completed the same task while wearing goggles that simulated severely degraded vision (reduced acuity and contrast sensitivity). We will discuss possible accounts to explain the effects of walking speed on cognitive load at these severe levels of visual impairment and propose future work exploring other types of strategy use for navigating with different types of vision loss.

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### Top-down effects of meter induction on audition and vision.

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This study seeks to shed light on the nature of meter induction, the musical ability to organize isochronously-perceived beats in hierarchical structures. Recent research demonstrated top-down effects of meter induction on the auditory modality. We aim to assess whether those effects are also present in the visual domain. Sixteen musicians were asked to internally project binary (i.e. a strong weak pattern) and ternary (i.e. a strong-weak-weak pattern) meter onto separate, analogous visual and auditory isochronous stimuli. Participants were presented with sequences of tones or blinking circular shapes at 2.4 Hz while their electrophysiological responses were recorded. The frequency analysis of the elicited steady-state evoked potentials allowed us to compare the frequencies of the beat (2.4 Hz), its first harmonic (4.8 Hz), the binary subharmonic (1.2 Hz), and ternary subharmonic (.8 Hz) within and across modalities. Taking the amplitude spectra into account, we observed an effect at 0.8 Hz in the ternary condition for both modalities, which may support cross-modal meter induction. Moreover, an interaction between modality and magnitude was found at 2.4 and 4.8 Hz. After using the control condition as a baseline, the power spectra revealed significant differences from zero in the auditory, but not in the visual, binary condition at 1.2 Hz. These findings suggest that meter processing is modulated by top-down mechanisms that interact with our perception of rhythmic events and that such modulation can also be found in the visual domain.

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### Does Diabetes Lead to Decrements in Memory and Attention in Adults With Cystic Fibrosis?

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Advances in medical care have led to people with cystic fibrosis (CF) living longer. CF-related diabetes develops as a consequence of this longevity; 50% are diabetic by the age of 30 years. Type 1 and type 2 diabetes have deleterious effects on cognitive performance. This study aimed to elucidate the nature and severity of any cognitive impairment in patients with CF-related diabetes compared to non-diabetic patients with CF and healthy controls. 49 patients with CF-related diabetes and 49 non-diabetics registered to a large UK Adult CF Unit were recruited. 49 healthy matched controls were recruited from the general population. Cognitive performance was assessed using the Cambridge Neuropsychological Test Automated

Battery (CANTAB). Compared to controls, patients with CF-related diabetes performed significantly worse than controls on tests of mental flexibility and processing speed, which is consistent with the pattern of impairment shown in type 1 diabetics, and on verbal memory and learning, which is consistent with the pattern of impairment shown in type 2 diabetics. Compared to non-diabetic patients, those with CF-related diabetes performed worse on tests of visual sustained attention, verbal memory, working memory, and processing speed. CF-related diabetes has a negative impact on cognitive performance akin to type 1 and 2 diabetes. Non-diabetic patients with CF also show impaired cognition but to a lesser degree than CF-related diabetics. Even modest cognitive impairment in adults with CF may impact upon their quality of life and ability to manage a complex medical regimen which is essential in CF care. Email: Helen Chadwick, [h.k.chadwick@leeds.ac.uk](mailto:h.k.chadwick@leeds.ac.uk)

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### Effects of Sensory Consonance on the Detection of Abstract Patterns: A Comparative Study.

PAOLA CRESPO-BOJORQUE, *Universitat Pompeu Fabra*, JUAN M. TORO, *Universitat Pompeu Fabra / ICREA*.

Previous research on consonance, a salient perceptual feature in harmonic music associated with pleasantness, suggests that consonant intervals are more easily processed than dissonant intervals. In the present work we explore from a comparative perspective if this processing advantage extends to more complex tasks such as the detection of token-independent structures. We ran experiments on rule learning over consonant and dissonant intervals with non-human animals and human participants. Results show differences across species regarding the extent to which they benefit from differences in consonance. Rats learn abstract rules with the same ease independently of whether they are implemented over consonant or dissonant intervals. In contrast, processing advantages for consonance over dissonance were observed in human participants. They learn an abstract rule better when it is implemented over consonant than over dissonant intervals. Moreover, their performance improves when there is a mapping between abstract categories defining a rule and consonant and dissonant intervals. Results suggest that for humans, consonance might be used as a perceptual anchor for other cognitive processes as to facilitate the detection of abstract patterns. Lacking extensive experience with harmonic stimuli, non-human animals tested here do not seem to benefit from a processing advantage for consonant intervals.

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### Researching Equality: The Effects of Mental Rotation Training on Preschool Education with Absence of Differences between Boys and Girls.

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Mental rotation (MR) is one of the most studied spatial skills in spatial cognition. However, controversy remains concerning its onset in development, its susceptibility to training, the mean differences between sexes and its relationship with other cognitive skills. To date, there is evidence that spatial skills training leads to their improvement (Uttal et al., 2012), although studies with infants

are rare. The present study aims to observe the effectiveness of MR training and its relationship with various tasks involving various aspects of cognition such as visualization, the visuospatial working memory, fluid intelligence and math in the 1st year of preschool. A total of 58 children aged between 3 and 4 years took part in this study, 29 of which conducted a MR training program over 3 sessions. The training effectiveness in the experimental group compared to the control group, as well as gender differences before and after training were analyzed. The results showed significant improvement of mental rotation ability in the experimental group measured through a test different to the test used in training. No differences between sexes were found or between groups on tasks that measured visualization, fluid intelligence, math or visuospatial working memory. As previous studies and meta-analysis have shown, these results support the malleability of spatial skills and can help implement education policies.

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### Effects of a Program of Cognitive Stimulation with Leisure Activities and Games for Elderly.

ELISABETH GRIMAUD, *University of Tours, Centre de Ressources pour la Cognition*, DAVID CLARYS, *University of Poitiers*, LAURENCE TACONNAT, *University of Tours*. The influence of leisure activities on everyday functioning is largely under investigated. Nevertheless, there are several relevant criteria emerging from the literature that support the efficacy of cognitive interventions using leisure activities (Kelly et al., 2014; Tesky et al., 2011; Tranter & Koutstaal, 2008). This study investigates the impact of a method of cognitive training with leisure activities like games on the cognitive functioning of older adults without known cognitive impairment. Forty people were included: twenty four people in a control group and sixteen participants in cognitive training groups. The intervention consisted of 8 weekly sessions. We examined transfer and maintenance of intervention effects over executive functions (working memory, processing speed, shifting, updating, inhibition) and self-esteem. Results revealed that compared to active controls, cognitive training improved performance on measures of executive function (working memory,  $p < 0.05$ ; processing speed,  $p < 0.05$  and inhibition  $p < 0.01$ ) and on self esteem ( $p < 0.05$ ) but provides no benefits on shifting and updating. More research is required to determine which kind of leisure activities can improve cognitive and everyday functioning. Email: Elisabeth Grimaud, [eli.grimaud@gmail.com](mailto:eli.grimaud@gmail.com)

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### Sex Differences in Chronometric Mental Rotation with Human Bodies.

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The present experiment investigated sex differences across stimulus types in a chronometric mental rotation task. The working hypothesis was that human bodies as stimuli would reduce the magnitude of sex differences compared to cubes as stimuli, from the embodied cognition perspective. One hundred and twenty participants, 60 men and 60 women solved chronometric mental rotation items with Shepard-Metzler cube figures, head-cubes, and human bodies, all designed so that they were similar in shape.



Two figures of a given stimulus type were presented on the screen and participants had to judge if both items were mirrored or non-mirrored. Results showed better mental rotation performance with human bodies than with other types of stimuli for both sexes, although the effect of stimulus type was more pronounced in men than in women. Furthermore, regardless of stimulus type, men were more accurate than women. Altogether, the results suggest that sex differences are not reduced when human bodies are used as stimuli in a chronometric task. Implications for accounts of sex differences in mental rotations are discussed.

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### Computer Learning Supports Cognitive Functions In Elderly.

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Nowadays, cognitive decline is one of the greater threat for the health of old people. Since the average age of population rises, in the near future the number of people affected by cognitive decline will increase, with the need of developing strategies of intervention. The use of digital devices and technology may be helpful as it may stimulates the elderly's cognitive functions. In 4 tasks tapping semantic memory and cognitive control (Simon task, Picture-word interference, Semantic fluency, Word categorization) we investigated whether learning to use a computer in old age (>65 years old) has a positive impact on the individual's cognitive functions. We adopted a longitudinal design: Participants (N=20, age range=65-83) were recruited among people attending a computer course and tested first at the beginning of the course (T1), and then 10 months after the first test (T2). A control group of elderly participants not using a PC was also tested twice, with a 10-months interval between the two sessions. Results show that, while the performance of the control group worsened at T2 in all the tasks, that of the experimental group was stable for both the Simon and the Picture-word interference task, and even improved at T2 for the Semantic fluency task. The word categorization task was not sensitive to changes in either group. Taken together, these findings suggest that learning to use a computer in old age may help individuals to maintain some cognitive functions involving semantic memory and cognitive control.

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### Role of Inter-Stimuli Interval Time in Strategy Sequential Difficulty Effect in Memory in Young and Older Adults.

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Introduction: Strategy Sequential Difficulty Effect (SSDE) in the memory domain refers to poorer recall performance after having learnt information by using a difficult strategy than after having learnt information with an easy strategy. Difficult strategies temporarily consume central cognitive resources and slowing down execution of the following trial. This effect is equivalent in young and older adults (Uittenhove et al., 2014). The goals of this study were to confirm SSDE in memory, to identify the mediators of this effect and to explore whether SSDE could be reduced when the time between the presentations of two stimuli increases. Material

and methods: In experiment 1, young and older adults had to learn two lists of 30 words with an ISI time (inter-stimuli interval) of 500 ms. The target words were learnt with a sentence construction strategy, and were presented either after words learnt with a repetition strategy (easy trial) or words learnt after an imagery strategy (difficult trial). Executive functions and processing speed were assessed. In experiment 2, the same protocol was used in two age groups but we varied the ISI time (1000ms vs. 2000ms). Results and Conclusion: SSDE was correlated with inhibition for both groups and with processing speed only in the older group. When the ISI time increased, the SSDE was no more significant in the younger group but persisted in the older group. SSDE is a robust effect which remains significant in older adults, which corroborates an age-related impairment in switching from a strategy to another. Email: Lucile Burger, [luccile.burger@etu.univ-tours.fr](mailto:luccile.burger@etu.univ-tours.fr)

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### Behavioral Dynamics of Rhythm Perception: The Effect of Musical Expertise.

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#### Background

Rhythm perception is the result of a dynamic process in which listener's attention synchronizes to the perceived metrical structure, leading to a modulation of expectancy as a function of time. In the current study, we investigated whether musical expertise modulates the perception of rhythmical structures and the detection of auditory deviant stimuli inserted within rhythmical and non-rhythmical auditory sequences. Our hypothesis is that long-term musical training leads to better rhythmical perception due to an increased sensitivity to the metrical structure and/or better temporal predictions.

#### Material and Methods

We tested professional musicians and non-musicians on the detection of auditory deviant stimuli in rhythmical and non-rhythmical conditions. Participants listened to continuous auditory sequences and made manual responses when they detected an auditory deviant stimulus. We used two types of deviant stimuli: sounds with a slightly higher frequency and triplets of sounds with a different interval of time between sounds.

#### Results

Musicians' RTs to deviant stimuli were significantly faster relative to non-musicians. Additionally, musicians missed fewer deviants than non-musicians in all conditions. Interestingly, the detection of temporal deviants within non-rhythmical sequences caused the highest percentage of missed deviants for non-musicians.

#### Conclusions

The findings support the view that rhythmical sequences differently modulate attentional resources over time in musicians, facilitating the perception of deviant stimuli because of an enhanced sensitivity to the metrical structure and an improved temporal prediction mechanism.

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### Experiential Origins of the Mental Time Line and the Mental Number Line.

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People conceptualize both time and numbers as unfolding along a horizontal line, either from left to right or from right to left. The directionality of the mental timeline (MTL) and mental numberline (MNL) have both been assumed to depend on the direction of reading and writing within a culture. Here we challenge this assumption, proposing that different culture-specific experiences determine the directions of the MTL and the MNL. First, we tested the effects of reading direction on the direction of the MTL and MNL. Participants read English text either normally (from left to right) or mirror-reversed (from right to left). After normal reading, participants showed the space-time associations and space-number associations typical of Americans. After mirror reading, participants' space-time associations were significantly reduced but their space-number associations were unchanged. Next, we tested the hypothesis that finger-counting habits can determine the direction of the MNL. English speakers were trained to count on their fingers from left to right or from right to left. After rightward counting, participants showed implicit associations of small numbers with left space and large numbers with right space, typical for Americans. After leftward counting, this space-number association was significantly reduced, overall, and was qualitatively reversed in a significant proportion of the individual participants. These data suggest that the MTL and MNL have different experiential bases. Whereas the MTL can be shaped by reading direction, the MNL is sensitive to other culture-specific practices that, like finger counting, spatialize numbers.

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### Eye-Movements and Mental-Rotation Performance: A Chronometric Study.

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Differences in the solution strategy are a possible explanation for the gender differences usually found in mental-rotation tests. To examine the influence of the solution strategy on performance we administered a chronometric mental-rotation test which was based on pair comparisons and connected with an eye-tracker to 44 female and 37 male participants (age:  $M=23.29$ ;  $SD=8.98$ ). On the basis of the eye movements registered and the time spent looking at one cube figure before switching to the other one (time per picture) the sample was divided into slow switchers and fast switchers (median split). We assumed that subjects with a holistic strategy would switch faster than subjects using an analytic strategy, because the latter spend more time to analyze a figure before switching. T-tests comparing slow and fast switchers showed highly significant differences in error rate ( $t=-2.907$ ;  $p=.005$ ;  $\eta^2=.095$ ), reaction time ( $t=-7.743$ ;  $p=.000$ ;  $\eta^2=.429$ ), rotational speed ( $t=2.914$ ;  $p=.005$ ;  $\eta^2=.097$ ), and perceived difficulty ( $t=-2.448$ ;  $p=.017$ ;  $\eta^2=.071$ ). The fast switchers had fewer errors, reacted and rotated faster, and rated the task as less difficult. Female participants rated the task as more difficult than male participants ( $t=-2.904$ ;  $p=.005$ ;  $\eta^2=.098$ ), but in any of the performance measures no gender difference was found. Results show that either switching faster is beneficial for mental-

rotation performance in general or that, independent of gender, an effective mental-rotation strategy leads the subjects to switch faster.

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### Healthy Ageing and Binding in Visual Working Memory: Mixed Versus Blocked Designs.

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It is well established that healthy older adults exhibit an associative memory deficit for pairings of distinct items. However, the effect of healthy ageing on temporary memory for conjunctions of objects features (e.g. colour and shape) is unclear. This issue has potential practical implications given the pronounced working memory binding deficit observed in Alzheimer's disease. According to a dual-process account, accurate recognition of a binding change requires that participants recollect the exact pairing of features presented whereas detection of a feature change can be achieved on the basis of familiarity alone. It has been suggested that older adults may rely to a greater extent on feelings of familiarity during recognition tasks and, consequently, when feature and binding change trials are presented in the same trial-block older adults will tend to miss the less salient binding changes. Across several experiments we assess the effect of mixing versus blocking trials on older adults' ability to recognise conjunctions of features (colour, shape, location) in visual working memory (VWM). We repeatedly find that the effect of age on VWM for feature bindings is no greater than for individual features, in line with previous work. Further, we find evidence that mixing different types of trial does not increase the likelihood that older adults will miss binding changes. These findings are discussed in reference to associative deficits in long-term memory, with focus on the difference between relational and conjunctive binding mechanisms.

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### Language Processes

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### Anticipatory Processing across Domains: An Individual Differences Study.

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Prediction has been observed across various psychological domains, and has been argued to be a fundamental aspect of mind and brain (e.g., Clark, 2013). For example, language comprehenders anticipate upcoming linguistic input: comprehenders hearing "The boy will eat..." fixate an edible *cake* more than an inedible *ball* (e.g., Altmann & Kamide, 1999). However, how anticipatory processes relate across different psychological domains is not well understood. The current individual differences study investigated anticipation across two domains: (1) implicit anticipation of upcoming linguistic input during language comprehension, measured via anticipatory fixations in the visual world paradigm (e.g., Altmann & Kamide, 1999), and (2) explicit self-reported orientation toward the future, measured via the Zimbardo Time Perspective Inventory (e.g., "When I want to achieve something, I set goals and consider





specific means for reaching those goals"; Zimbardo & Boyd, 1999). We found ( $N = 45$ ) that individual differences in anticipatory fixations did not predict future orientation scores (Pearson's  $r = .16$ ,  $p = .29$ ), but showed weak relationships with other aspects of time orientation. These results shed new light on the domain generality vs. specificity of anticipatory processes.

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### Activation Spreading in First and Second Language Speakers during Word Production.

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Some studies claim that comprehension lies at the core of self-monitoring (Levitt, 1983, 1989) while others believe that competition between two representations is responsible (Nozari, Dell, Schwartz, 2011). In support of the latter view, previous experiments have shown that monitoring slows down when there is competition between two lexical representations. In these experiments, participants were asked to perform a phoneme monitoring task in picture names that interfered with word distractors. Participants were asked to decide whether a particular phoneme was present in a picture name. We created three experimental conditions with different numbers of overlapping phonemes between the picture name and distractor word. Dutch-English bilinguals performed the task in their native and second language. The place of the target phoneme and the number of overlapping phonemes interacted with the interference effect elicited by the distractor word. Furthermore, the effect was dependent on the proficiency of the speaker when monitoring speech in a second language. The main goal of the study to be performed is to see where this slow-down in monitoring is seen. Participants will perform an experiment that consists of three parts and is performed in their native and second language. In the first part, participants monitor a phoneme while the target word is presented auditorily (perception). During the second part, phoneme monitoring is performed while the words are visually presented (production). Finally, a picture naming task is performed. By comparing results of these experiments, we can shed more light on the nature of the speech monitoring process.

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### Lexical Differentiation and the Discourse History.

SI ON YOON, SARAH BROWN-SCHMIDT, *University of Illinois, Urbana-Champaign*. Background: Speakers typically take into account both the local context, as well as the discourse history when designing definite referring expressions. Here we examine the phenomenon of Lexical Differentiation, which refers to the tendency of speakers to elaborate their referring expressions with modifiers, e.g., "the striped shirt", if a different exemplar from the same category had been mentioned in the past, e.g. "the shirt". Little is known about why speakers choose to differentiate. The differentiation rate is typically low (ranges from ~5% to 25%).

Methods and Results: Pairs of naïve participants completed a referential communication task in which a speaker described objects for a listener to click on. Scenes contained 4 objects; 1 object was designated as the target on each trial. On critical trials a target referent (e.g., striped shirt) was from a category that a different exemplar (e.g., dotted shirt) either had (differentiation trial) or

had not (non-differentiation trial) previously been described. A recognition memory task followed, and probed memory for the pictures. We find that failures to differentiate are not due to forgetting what has been talked about in the past. Instead, speakers choose to differentiate when they perceive the past as relevant to the current topic of discussion. We also find a speaker-benefit in memory for things that have been discussed, and equivalent speaker and listener memory for the discourse context.

Conclusions: These findings suggest that it is perceived relevance, not memory limitations, that influence whether speakers design language with respect to the historical discourse context.

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### Grammatical Gender and Sex Features in Language Processing.

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The aim of the study is to explore the sex and gender dimensions relationship in speech communication. The interaction between the gender of the word and the type of gender (biological or grammatical), the sex of the speaker and the sex of the addressee is explored, with the general objective to create a complete view of gender processing in Spanish. For this purpose, different tasks are used in which the gender activation come from the conscious domain (gender decision) and from the unconscious one (lexical decision), with the presentation of words in auditory and visual modalities. In the gender decision task, when there is a match between the gender of the word and the sex of the participant or the sex of the speaker, a faster and more accurate processing is observed. The same effect related to the sex of the speaker was found in the lexical decision task, but only with the women's group and for biologically gendered words. When paying direct attention to the gender, the own sex is facilitating the classification of the word's grammatical gender if there is a match between the two dimensions. Hearing the voice of a speaker, which corresponds in gender with the word, facilitates the processing of the syntactic features: the grammatical gender and its lexuality. The sex feature acts as a prime activating the lexical candidates of the same grammatical gender in the gender decision task, meanwhile in the lexical decision, the link appears more related to the biological gender.

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### A Joe by Any Other Name: Mixed Distractors Facilitate Proper Name Retrieval.

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Research on object names using the picture-word interference paradigm has demonstrated that presenting a distractor word with a to-be-named target picture influences production: Phonologically-related distractors facilitate target naming, while semantically-related distractors interfere with naming and mixed (semantic and phonological) distractors attenuate semantic interference. However, less is known about the factors that influence *proper name* production. These experiments investigated (1) the influence of distractors on production of proper names, and (2) whether participants' *familiarity* with the distractor moderates the influence of specific distractors. In Experiment 1, young adult participants

were presented with a picture of a famous person's face (e.g., *Joe Biden*) simultaneously with either a written (1) semantic distractor (sharing occupation; e.g., *Ron Paul*, politician), (2) phonological distractor (similar-sounding first name; e.g., *Joe Paterno*), (3) mixed distractor (semantically and phonologically similar; e.g., *Joe Lieberman*; politician), or (4) unrelated name (e.g., *Dan Aykroyd*). In Experiment 2, target names were only paired with a mixed distractor and an unrelated name, and participants rated their familiarity with the distractor. Each individual's median familiarity rating was used to categorize distractors as high (above the median) or low (below the median) in familiarity. Both experiments illustrated that mixed distractors facilitated accurate naming of the target pictures relative to unrelated distractors, only when distractors were highly familiar to the participant (Experiment 2). These results support the idea that proper names are stored and retrieved differently than other types of words and emphasize the importance of person-specific factors, like personal familiarity, in proper name production.

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### Exposure to a Second Language Can Change Processing Routines in the First Language.

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Background: Research suggests that long-term immersion in a second language (L2) can shift parsing routines in the first language (L1) (1). We probe the dynamics of this shift by testing whether short-term exposure to L2 structures can change bilinguals' processing strategies in their L1. We investigated this in the context of syntactically-ambiguous relative clauses:

(i) *Arrestaron a la hermana del hombre que estaba enferma.*

Someone arrested the sister of the man who was <sup>FEM</sup> ill. 'Que estaba enferma' is temporarily ambiguous: it can modify 'hermana' (high attachment=HA) or 'hombre' (low attachment=LA). Because 'enferma' is marked with feminine gender, the correct interpretation requires the relative clause to modify 'hermana.'

Method: 54 L1 Spanish-L2 English speakers participated in a 3-phase study. Phase-1 employed eyetracking to assess participants' initial preference (HA or LA) when reading Spanish sentences like (i). Phase-2: participants were administered a 5-day 'treatment' in Spanish or English that exposed them to relative-clause constructions favoring the attachment opposite to their initial preference. Phase-3: eye-movement records were collected immediately after the treatment (posttest) and one week later (delayed posttest) to determine the effect of treatment.

Results: "Low attachers" receiving a high-attachment treatment in Spanish and English showed evidence of high-attachment preferences at both posttests. "High attachers" receiving a low-attachment treatment in English showed low-attachment preferences but only at the delayed posttest, suggesting the need for a period of consolidation. "High attachers" receiving a low-attachment treatment in Spanish showed a temporary shift toward low-attachment preferences. Results support usage-based models of sentence comprehension (2).

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### The Role of Phonological and Orthographic Coding in Skilled Deaf Readers.

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Written language is very important as the main channel for acquiring and communicating knowledge in our daily life. However, most deaf people never achieve a good reading level compared with hearing pairs (Conrad, 1979). Most previous research has focused on the difficulties of deaf readers in relation to phonological processing (Colin, Magnan, Ecalte & Leybaert, 2007; Kelly & Barac-Cikoja, 2007). Other studies showed that the skilled readers might activate visual, orthographic and semantic codes (Bélanger, Baum & Mayberry, 2012). The present experiments focus on the orthographic and phonological processes used by deaf skilled readers who read in Spanish, a language with a transparent orthography. We carried out two lexical decision tasks with a group of 17 skilled deaf readers and compared their orthographic and phonological abilities to those of 17 hearing skilled readers matched on age, IQ and reading level. In one of the experiments, we found a transposed-letter inhibitory effect in both groups, showing an activation of orthographic codes in deaf and hearing. In the other experiment, the results for hearing readers replicated findings in the literature (Ferrand & Grainger, 1994): pseudohomophones were harder to reject than control nonwords, showing an inhibitory effect due to the influence of phonology. However, this effect is not present in the skilled deaf readers, who do not seem to activate phonological codes to perform the task successfully. This shows evidence that phonology is not required to achieve a proficient reading level and this can be achieved with other strategies.

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### Masked Translation Priming with Cognates and Noncognates: Is There An Effect of Words' Concreteness?

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In the domain of bilingualism, the extent to which the two languages are shared at a conceptual level has been a widely investigated topic. Even though progress has been made in the last decades, there are still some theoretical gaps related to the effect of different variables on the access of words to the conceptual system. In the present study, we focused on word type. We aimed to test the proposal of the Distributed Feature Model (DFM, de Groot, 1992), according to which the degree of meaning overlap between translation equivalents depends upon the type of word represented, being larger for cognate words (translation equivalents with a similar form, i.e. "papel-paper" in Spanish and English, respectively) than for



noncognate words (translation equivalents without any similarity in form, i.e. “*libro*-book”). Similarly, as the model holds that concrete words share a greater number of semantic features across languages than abstract words, we aimed to explore if this variable modulates cognate processing. We tested proficient unbalanced Spanish-English bilinguals, by orthogonally manipulating for the first time concreteness and cognate status of words in a masked translation priming paradigm conducted in the two translation directions. The stimulus onset asynchrony (SOA) was also manipulated (50-ms vs 100-ms) in order to explore the time-course priming effects. Results revealed modulations in masked priming effects as a function of cognate status and translation direction but null effects of concreteness. These results have implications for our understanding of the bilingual memory.

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### **Locus of Language Selection in Bilingual Word Production: When Is Early Selection Possible?**

NORIKO HOSHINO, *Kobe City University of Foreign Studies*, LAURA RODRIGO CRISTOBAL, *Autonomous University of Madrid*, HIROMU SAKAI, *Waseda University*. When bilinguals plan to speak, both of their languages are activated regardless of language similarity. However, some past research suggests that language similarity may modulate the degree of language co-activation and the locus of language selection. The present study was designed to further examine this issue. Specifically, Japanese-English bilinguals whose two languages differed in script were asked to perform a picture-word interference task. Half of the participants named pictures in English while ignoring visually presented Japanese distractor words. The other half named pictures in English while ignoring English distractors. Distractor words were (1) phonologically related to English picture names, (2) semantically related, (3) phonologically related to the translation of English picture names (i.e., Japanese picture names), or (4) unrelated. It was predicted that Japanese-English bilinguals would select the language of production earlier when the distractors were visually presented in Japanese (i.e., when a script difference was present in the stimulus) than when the distractors were presented in English. According to the preliminary analysis, the bilinguals who received the English distractors showed significant or marginally significant phonological, semantic, and phono-translation effects, whereas those who received Japanese distractors showed only a phonological effect. These results suggest that Japanese-English bilinguals appear to select the language of production early by exploiting script differences that are perceptually available in input. The implications of the results will be discussed for the models of lexical access during bilingual word production.

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### **Validation and Integration of Inconsistent Information: A Two-Step Model of Comprehending Negative-Causal Coherence Relations.**

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Previous studies have shown that processing negative-causal coherence relations is cognitively more demanding than processing

positive-causal relations. But what causes these increased cognitive demands? One explanation might be that we immediately validate incoming information during text comprehension against prior text discourse and world knowledge. When the validation outcome is negative cognitive effort is increased. Negative-causal relations such as *Anna is ill. Nevertheless, she goes to school* link two statements that are inconsistent with common knowledge. We assume that, first, this inconsistency must be detected through immediate and routine validation. Second, it has to be resolved through elaborative processing to establish a coherent mental model.

In a self-paced reading task, participants ( $N=56$ ) read short texts containing either a positive-causal or negative-causal sentence pair (e.g. *Linda is invited to a costume party. All guests are required to wear a beautiful/spooky costume. Therefore/Nevertheless Linda is dressed as a princess at the party*). LMM analyses revealed longer reading times for critical information in the third sentence of negative-causal items (*princess*) which is inconsistent with the second sentence as compared to positive-causal items. This suggests that inconsistencies in negative-causal items were immediately recognized and validated against pertinent knowledge. Furthermore, longer reading times were obtained for the final area of the third sentence (*at the party*) for negative-causal as compared to positive-causal items indicating difficulties to integrate inconsistent information into the existing mental model of the text. Our results support a two-step model – detection through validation and integration of inconsistent information – of comprehending negative-causal coherence relations.

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### **Gestures Accompanying Spontaneous Oral Discourse in Speakers with Fluent versus Non-fluent Aphasia.**

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Whether and how co-verbal gestures facilitate word production and play a communicative role among persons with aphasia (PWAs) is an empirical question, with mixed findings reported in the literature thus far. This study aimed to investigate whether the overall frequency of gestural employment and the distribution of gesture forms and functions varied across 23 fluent PWAs, 21 non-fluent PWAs, and 23 age- and education-matched controls. How well the factors of complexity of linguistic output, aphasia severity, semantic processing integrity, and hemiplegia would predict frequency of using gestures among PWAs was also examined using a multiple regression analysis. Three sets of language and video files were collected through the narrative tasks of recounting an important event, sequential description, and story-telling. While the language samples were linguistically quantified to reflect word-, sentential-, and discourse-level performance, the videos were annotated for the form and function of each gesture. All PWAs were also assessed on their verbal and non-verbal semantic skills, oral naming abilities, aphasia syndromes and severities, and degree of hemiplegia. Our results indicated a significantly higher gesture-to-word ratio in non-fluent PWAs, as compared to fluent PWAs and controls. While deictic gestures were the most frequently used form of content-carrying gestures for all three speaker groups, both fluent and non-fluent PWAs tended to use gestures to enhance the speech content and assist lexical retrieval. The results of multiple regression showed that only the percentage of complete sentences



and dysfluency significantly predicted gesturing rate in PWAs.  
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### Disentangling Semantic and Orthographic Satiation Effects: A Study of Chinese Words.

CELINE NIEN-CHEN LEE, JANET WEBSTER, DAVID HOWARD, *Newcastle University*. Semantic satiation refers to attenuation of a word's meaning after prolonged inspection or massive repetition. Evidence from semantic satiation paradigms and free association tasks in English shows that a massively repeated prime inhibits semantic accessibility to semantically related words. Another seemingly similar satiation effect in Chinese was found in lexical decision tasks with matrix design, which current evidence suggests is purely orthographic. However, this claim remains inconclusive due to potential visual distraction and confounds between orthographic and semantic relatedness in previous Chinese studies. This study aimed to disentangle the contribution of semantic and orthographic relatedness to the satiation effect on Chinese two-character words. A semantic relatedness task within a semantic satiation paradigm with 1 (as a baseline), 3 and 30 repetitions of primes was designed, with manipulation of orthographic similarity at character and radical levels. 18 native Chinese speakers from Taiwan completed the experiment. Multivariate analysis of variance (MANOVA) was carried out. By subjects analyses showed a main effect of orthographic condition and an interaction between number of repetitions and Yes/No responses. Orthographically related targets were slower to reject and accept than orthographically unrelated ones. Judgement of semantically related responses (Yes responses) significantly slowed with increased repetitions, and such satiation applied only to semantically related responses, showing a typical semantic satiation effect. Moreover, this satiation effect affected all orthographic conditions equally, suggesting that the orthographic effect does not accumulate as repetitions increase. These findings suggest that the satiation effect obtained in previous Chinese studies is actually semantic, rather than orthographic.

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### Comparing Two Automatic Assessment LSA's Methods: Inbuilt Rubric vs Golden Summaries.

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The aim of this study was to compare two automatic assessment methods using LSA: a classical method, Golden Summaries (Kintsch et al., 2007) in which each student summary was compared to an ideal answer or golden text, and Inbuilt Rubric (Olmos et al., 2014), that accommodates an expert rubric through lexical descriptors into a LSA semantic space transforming these LSA space in such a way that the first dimensions captures the meaning of the rubric. To validate this method it was elaborated four versions of the rubric in order to few/many lexical descriptors, and weighted/not weighted with LSA dimensions. 81 university students summarized an expository text (1,300 words) about Darwin's evolution theory. Four expert judges assessed these summaries, and created the rubric via lexical descriptors. Results showed that correlations between the two weighted versions (few

and many descriptors) of Inbuilt Rubric were significantly higher ( $r = .78$  and  $r = .77$ ) than correlation between expert grades and Golden summaries ( $r = .67$ ). These findings indicate that the Inbuilt Rubric method simulates human assessment better than Golden's LSA method. Inbuilt Rubric method transformed a latent space into a topic or meaningful semantic space. As the dimensions represent concepts from a rubric, Inbuilt Rubric detected which contents are or not included in a student essay without creating partial Golden Summaries.

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### Gender-Congruency Effects in the Production of German Compound Nouns.

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We examined how compound nouns and their gender are lexically stored and accessed in speech production. In German, grammatical gender of noun-noun compounds (e.g., Teekanne<sub>fem</sub> [tea pot]) is determined by the morphological head (Kanne<sub>fem</sub> in Teekanne<sub>fem</sub>), the gender of the modifier (Tee<sub>masc</sub> in Teekanne<sub>fem</sub>) is irrelevant. Using gender-marked determiner primes, we tested for specific effects from determiners in/congruent with the modifier to address the question of whether modifier and head are processed independently at a syntactic level (multiple-lemma representation). Compound targets were combinations of two nouns, differing in gender (e.g., Tee<sub>masc</sub> kanne<sub>fem</sub>). Experiment 1 assessed effects of auditory determiner primes in bare noun picture naming and Experiment 2 assessed effects of visual determiner primes in determiner-noun picture naming. Three prime conditions were tested: (a) determiner congruent with compound / head (die<sub>fem</sub>, for the given example), (b) determiner incongruent with head and modifier (das<sub>neuter</sub>), and (c) determiner congruent with modifier (der<sub>masc</sub>). We predicted faster responses in condition (a) vs. (b) and – if the constituents of the compounds are processed independently at a syntactic level – slower responses in condition (c) vs. (b). In both experiments, naming latencies were fastest with determiner primes congruent with the compound / head. However, naming latencies were not affected when determiners were congruent vs. incongruent with the modifier. The results corroborate a single-lemma representation of compound nouns in the German production lexicon.

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### Hemispheric Specialization for Emotion Words in Bilinguals: Effects of Valence and First Language.

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Emotion representation in monolingual speakers is complex and for bilinguals the relationship between emotion and language can be even more intriguing. The present study examined reactions to words of six types, including positive, negative, and neutral words varying in concreteness. Participants were Spanish-English bilinguals who were presented with both English and Spanish stimuli in a lexical decision task using hemifield presentation. Results showed an overall left hemisphere advantage. Positive words were reacted to more quickly than negative or neutral words with the magnitude of the effect varying by hemifield of presentation. Results are consistent with the valence hypothesis





of special processing for positive emotions in the left hemisphere of the brain and negative emotions in the right hemisphere of the brain. However, this pattern of emotion representation in the brain was found for bilingual participants only in their first language (L1), despite high proficiency in their second language, suggesting a unique representation of emotion in a bilingual speaker's L1 that may not extend to their L2 despite high proficiency.

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### **Effects of Sleep and Phonological Abilities on Learning Morphological Inflections in an Artificial Language.**

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Sleep benefits learning of motor sequences new vocabulary and novel morphological inflections. The current study examined the sleep components associated with the protective effect of sleep on consolidation of morphological inflections. Twenty adults learned to make plural inflections in an artificial language. The inflections differed in frequency and in the degree to which they were predictable given base word phonology. Participants were trained in the evening, followed by a night of polysomnographic recordings. Performance was tested before and immediately after training, as well as 12 and 36 hours post training to examine fast and slower consolidation processes. Accuracy improved during training, and was preserved at the 36 hour post test specifically for the high frequency inflections. Participants' reaction time continued to improve after the end of training, demonstrating "off line gains", indicating consolidation. Interestingly, sleep measures were correlated with offline consolidation and with standardized measures of phonological and reading abilities. Moreover, it was found that improvement during training before sleep was negatively correlated with the duration of total sleep time and with time in REM stage the following night, but only for participants with low reading decoding skills. These results suggest that participants with low phonological awareness, who had more difficulties learning the inflections during training, required more REM time to process their new learning. These results points to the role of sleep in learning linguistic regularities in a second language and suggests that phonological skills modulate the effect of sleep on learning and consolidation of morphological inflections.

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### **Visual Feature Weighting in Letter Identification: Mono and Bi-Scriptal Readers of English and Arabic.**

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Recent work has shown that certain visual features are more important than others in letter identification (e.g. Fiset et al., 2008; 2009). Furthermore, in previous work we have found that the weighting/ranking of visual features differs for the Roman and Arabic alphabets and between expert and naïve viewers of the Arabic alphabet (Wiley, Wilson, & Rapp, 2015). One open question is whether bi-scriptal individuals with expertise with both Roman and Arabic alphabets have a single visual feature weighting that has been tuned by their bi-scriptal experiences, or multiple weightings that may be modulated it in an online manner by the script being

viewed. In this study, bi-scriptal readers of Arabic and English and mono-scriptal readers of only English completed same-different judgments on pairs of letters from both alphabets. Linear mixed effects modeling analyses reveal that the relative importance of a set of 14 visual features present in both scripts differs for the two alphabets differentially for the mono and bi-scriptal readers. These findings reveal a flexible weighting of the visual features that is influenced by both the stimulus set and viewer expertise. An additional finding indicates that more visually complex letters (determined by the total number of visual features) are processed more slowly by naïve viewers, but that this effect reverses with increasing experience such that complexity is a predictor of significantly faster and more accurate responses by expert viewers. Email: Robert W. Wiley, [wiley@cogsci.jhu.edu](mailto:wiley@cogsci.jhu.edu)

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### **Right Hemisphere: Leading or Supporting Role? An Electric Stimulation in an Aphasic Case Study.**

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In the last years there has been a debate about the role of the right hemisphere at the aphasia rehabilitation. Some researchers stated a beneficial role caused by a reorganization of the linguistic functions, while others thought that is detrimental because of the increase of interhemispheric inhibition. In the present study we use the transcranial electric stimulation in a patient with chronic aphasia to provide evidence supporting one of the two sides of the debate. With this goal, we made a double blind study with two mountings, both of them with positive stimulation (1 mA, 25 minutes) over left Broca area, but also applying positive stimulation at the contralateral area in one of them and negative in the other one. Coupled with each mounting, the patient received also a *sham* condition (short stimulation) as a way of control. During that stimulation we passed different subtests of the BETA battery. The results showed an improvement at a conductual level when the right hemisphere was under positive stimulation, which is specially relevant at the action naming task. No evidence of improvements was found with the negative stimulation of the right hemisphere. So, this data would support a beneficial role of the right hemisphere and an implication of the same in verb production.

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### **Gender and Number Lexical Representation in Visual Word Recognition of Spanish Scholars.**

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Gender is marked in Spanish by a final vowel -a, for feminine words, or -o, for masculine words. Plural words add to the gender mark a -s suffix. Some previous studies of visual word recognition, in adults, support a dependency for the access to plurals forms from the singular representations, being the gender, however, acceded directly for each, the masculine and the feminine form. Our goal was the study of the access and representation of gender at the first years of reading learning. Masculine dominant pairs of words (masculine form -marinero -sailor men- being more frequent than feminine form -marinera-sailor woman) and feminine dominant

pairs (enfermera-nurse woman/enfermero -nurse men) were selected to be presented individually in a visual lexical decision task, to scholars of 8 and 11 years. Similar manipulation was carried out with singular and plural forms to study number processing. Results showed that for masculine dominant pairs, the lexical decision was faster for the masculine word, but no differences were found for feminine dominant pairs. In a similar way reaction times for the singular dominant pairs times were faster for the singular form (cometa -kite) than for the plural form (cometas -kites), and no differences for plural dominant pairs (dientes -teeth/diente -tooth). These results were similar in both groups of age and seem to support a model of access and representation of gender and number based on a canonical masculine singular form, which could be the only represented at the lexicon, whereas feminine and plurals would be accessed by rules from that.

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### Learning and Memory

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#### False Recognition Within- and Across-Languages: A Spanish-English Study.

PEDRO B. ALBUQUERQUE, *University of Minho*, MARIA SOLEDAD BEATO, *University of Salamanca*, SARA CADAVID, *University of Minho*.

We studied false recognition in within- and across-language using the Deese-Roediger-McDermott (DRM) paradigm. In this paradigm, participants study lists of words (e.g., *hill, valley, climb, summit, top, molehill, peak, plain, glacier, and goat*) highly associated with a nonpresented critical word (e.g., MOUNTAIN). Later, in the memory test, participants falsely recall and/or recognize the critical words. Ninety adult native Spanish speakers participated in the present experiment. They studied 16 DRM lists, eight in Spanish and eight in English. The final recognition memory test included: studied words in the same language; critical words (false critical alarms) presented in the same language (within-language condition), and different language (across-language condition) used in the study phase; and unrelated words in Spanish or English. Participants were restrictively instructed to recognize studied words only when they were presented in the same language. Results showed a robust false recognition effect. In fact, participants falsely recognized critical words in both within- (Spanish-Spanish; English-English) and across-language conditions (Spanish-English; English-Spanish). Specifically, false memory was significantly higher in the within-language condition than in the across-language condition. Furthermore, Spanish-Spanish (L1) false recognition was higher than English-English (L2) false recognition. Instead, no differences were found between the low rates of false recognition in Spanish-English and English-Spanish conditions. In sum, high proficiency in Spanish leads to more false recognition in the within-language condition. Besides, employing different languages at study and test reduces equally false recognition in Spanish and English.

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#### Can a Single JOL Lead to Better Memory Improvement than Relearning in Memory-Impaired Patients? Preliminary Results in Schizophrenia.

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Cognitive deficits are core symptoms of schizophrenia. Schizophrenia patients have impaired memory, but their metamemory monitoring accuracy remains relatively preserved. The most common learning method, learning repetition, is not very effective on a long-term scale. More recently, the *testing effect* shows that testing is more efficient than relearning. But testing may be stressful. On the other hand, when people make a metamemory Judgment of learning (JOL), they make a covert attempt to retrieve the answer that can be considered as a self-testing. We observed that in students, a single learning session followed by a JOL was more effective than relearning for difficult, but not for easy word pairs. We explored in schizophrenia patients the effectiveness of a single learning followed by a JOL, by comparison with 2 learning sessions. The strength of the cue-target association was manipulated. After a word-pair (30 easy, 30 difficult) encoding phase, patients had either to re-study or to rate their JOL. A cued-recall test occurred 48 hours later. Preliminary results show that with respect to difficult material, patients who had monitored a JOL performed better than those who had re-studied ( $p < 0.04$ ). The difference was only marginal for the easy pairs ( $p = 0.05$ ). The results are in keeping with the retrieval effort hypothesis that assumes that more effort at encoding produces more benefits, and it seems effective also in these memory-impaired patients. If the results are confirmed with larger samples (in progress), monitoring could provide an interesting, less stressful learning strategy for patients with impaired memory.

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#### How Reactivating a Memory Influences What We Remember of It.

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The perspective of memory traces as immutable and stable currently falls into disrepair and reconsolidation hypothesis has emerged as an explanation to the malleable nature of memory. According to this hypothesis, after its reactivation, a consolidated memory could become again in state of vulnerability that traditionally characterized newly formed memories. The first demonstration that human declarative memory can be especially susceptible to interfering material presented after its reactivation was recently provided (Hupbach, Gomez, Hardt, & Nadel, 2007). The aim of the present study is twofold: to replicate Hupbach's findings; and further explore the consequences of the reactivation of a consolidated memory. Experiment consisted in 3-session procedure, each one separated for approximately 48 hours. In the first two sessions, participants learned two different sets of 20 objects. Critically, immediately before Set 2 learning, memory for Set 1 was reactivated, or not. In the 3<sup>rd</sup> session Set 1 memory was tested with a free recall task. Our results suggest that participants, who reactivated Set 1 at the 2<sup>nd</sup> session, intrude more Set 2 items than participants who not reactivated it. However correct recall of Set 1 items remain unaffected. Jointly these results suggest an update effect of Set 1 memory trace. In the present study, all participants



performed a recognition test with a source memory judgment. This task allow us to explore if the update effect extended to Set 2 items that were not previously recalled. Results are consistent with reconsolidation hypothesis and shed further light on the dynamics of memory trace.

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### **Salience Modulation in Human Perceptual Learning with Visual Stimuli.**

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Perceptual learning is conceptualized as the improvement in discrimination between two similar stimuli as a result of mere exposure. It has also been determined that alternated exposure to the stimuli is more effective than massed exposure. The usual explanations in terms of salience modulation propose that exposure makes the distinctive features of the stimuli more salient than the common features. In human research, this phenomenon has usually been investigated using complex visual stimuli such as faces or colored checkerboards. However, in many cases this improvement in discrimination can be explained by factors extraneous to perceptual learning, such as attentional biases. For instance, it has been proposed that the participants discriminate better between the stimuli merely because they learn where to look to find the relevant differences. To prevent this strategic confound and to directly ascertain the role of salience modulation in human perceptual learning, we developed a new procedure using pairs of similar color patches. Without the possibility of attentional biases to explain any improvement in discrimination, our task would allow us to unequivocally determine whether salience modulation processes are involved in human perceptual learning. Supported by research project PSI2012-31641 (MINECO, Spain).

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### **The Effect of Social Context on Implicit Learning and Its Consolidation.**

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One of the central questions in psychology concerns the mere presence of others and how the social context influences our actions and cognitive processes. Two social impacts are widely known in the literature: 1) people tend to align personal attitudes with those of their social groups, and 2) the presence of others can lead to better performance in certain tasks. The relationship between learning/memory processes and social context has not been investigated yet, although companions can fundamentally change our coding, retrieval, and consolidation processes. Our study aims to fill this gap by investigating how the presence of another person influences one aspect of non-declarative memory, namely implicit sequence learning. We also explored whether participants spontaneously learn their partner's sequence as a result of social alignment. We used a modified version of the probabilistic alternating serial reaction time (ASRT) task to measure sequence learning. Testing was divided into two sessions (with 24-hour delay); two participants

took place in the social condition and one participant in the control condition. Our results show that social context did not influence implicit sequence learning performance in the first session but led to better consolidation after the 24-hour delay. These findings suggest an interaction between non-declarative memory consolidation and the presence of others, and are further relevant not only in social psychology but also can help in deeper understanding of memory encoding, retrieval and consolidation.

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### **Test Sensitivity in Human Contingency Learning: Causal Structure and Cue Competition Revisited.**

HILARY DON, EVAN LIVESEY, *The University of Sydney*.

Cue competition effects in human contingency learning appear to be influenced by the causal nature of cue-outcome relationships. For instance, while blocking effects are reliably demonstrated in scenarios where cues are presented as causes, several studies have failed to find blocking in non-causal scenarios, which is typically taken as evidence for the contribution of sophisticated reasoning processes that consider the causal structure of events. Other cue competition effects, such as highlighting and the inverse base-rate effect, seem to be far less sensitive to the causal properties of the scenario. However, blocking is typically measured with continuous causal ratings of single cues, while highlighting and the IBRE are measured with discrete choices about combinations of cues. Although these measures may be differentially sensitive to learning and reasoning effects, surprisingly little effort has been made to compare their properties, for instance their sensitivity to causal information. This study therefore aimed to assess the sensitivity of blocking and other cue competition effects to causal scenarios across different test measures. Participants completed learning tasks with instructions indicating either a causal or non-causal relationship between cues and outcomes. Learning was then assessed with either continuous outcome-likelihood ratings, or discrete outcome choice. When measured by continuous ratings, blocking was evident in causal, but not non-causal scenarios. However, when measured by discrete choice, blocking was robust and equivalent in both causal and non-causal scenarios. The results suggest that contributions of associative memory and causal reasoning to cue competition effects may depend substantially on the test measure used.

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### **Perceptual Recombination and False Recollection: Demonstrating Context Dependency.**

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Recently, we found that the presentation of perceptually fragmented object pictures caused false recollections of having seen intact pictures, suggesting that perceptual fragments can erroneously bind in long-term memory. Here, we report three experiments exploring the context dependency of this perceptual recombination effect. In the encoding phase, participants viewed scenes with superimposed labels with object pictures (e.g., the word "dog" followed by a picture of a dog on a beach) or superimposed object labels without pictures (e.g., the word "lemon" on a beach). The misinformation phase aimed at creating false recollections for object pictures that

were not seen (e.g. lemon), by exposing participants to scrambled pictures (lime, orange, grapefruit) overlaid onto the congruent (e.g. beach) or incongruent (e.g. forest) scene. In the cued recollection phase, participants' memory for object pictures was tested using object labels as retrieval cues (without scene context). In Experiment 1, we found evidence that perceptual fragments evoked false recollections in a scene congruent manner, suggesting that perceptual recombination in memory is sensitive to spatial context. In Experiment 2, we found that this effect of spatial context was sensitive to temporal context, by manipulating the timing of the encoding and misinformation phases over 24 hours. In Experiment 3, it was found that reversing the order of the encoding and misinformation phases abolished the congruency effect implying that in addition to temporal context, trace consolidation may play a role in the formation of false recollections from fragmented percepts.

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### Retrieval Practice and Deductive Inference.

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Retrieval practice (i.e. the "testing effect") has been shown to benefit learning. However, the benefit has sometimes been attenuated with more complex materials that require integrating multiple units of information. Critically, Tran, Rohrer, and Pashler (2015) found that retrieval practice improves sentence memory, but not the drawing of inferences from the same sentences. In two experiments, we investigated whether this lack of benefit of retrieval practice for inferential ability was due to their particular implementation of retrieval practice, which may have hindered relational processing among the sentences. Adults learned four sets of 7-9 related sentences for five minutes each, by practicing retrieval for two sets, and rereading for the other two sets. On a final test 2 days later, subjects were tested with previously unseen inferential questions regarding the sentences. In Experiment 1, retrieval practice involved presenting all sentences at once, and asking subjects to retrieve a missing word from each sentence. In Experiment 2, retrieval practice involved free recall of the entire set of sentences at once. Also, feedback in the retrieval practice condition consisted of viewing the entire set of sentences, not one sentence at a time (as in Tran et al.). Overall, retrieval practice aided later deductive inference more than rereading. Our findings suggest that an appropriate implementation of retrieval practice is important for optimizing its utility, and to promote deductive reasoning from across multiple sentences one should facilitate relational processing among the sentences instead of encouraging their processing in a piecemeal fashion.

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### Guided Retrieval Practice and Vocabulary Learning in Sixth Grade Children.

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Retrieval-based activities, those requiring one to set aside the learning material and actively access already encoded information in memory, have been shown to enhance performance in a variety of

learning tests. While most of the studies on retrieval-based learning have been conducted with adult (college students) participants, recent work reveals that children may also benefit from these learning activities if they rely on guided rather than free recall. In one experiment we assessed the effectiveness of retrieval practice as a strategy to learn foreign vocabulary in fourth grade children. Sixty-six Spanish students were given a list of 15 Spanish-English word pairs and randomly assigned to three different conditions: In the Restudy condition the children studied the list at four different times. In the Cue Recall condition the children studied the list for 5 minutes and, at two different times, were given a sheet with the words in one of the two languages as prompts to recall the other. In the Free Recall condition the children studied the list and had two periods of 5 minutes to recall as many pairs as possible without recall cues. All the groups completed a vocabulary test 1 week after the learning phase. While the two retrieval practice groups showed enhanced learning relative to the restudy group, cue recall led to the best performance. These results support the idea that retrieval practice is an effective learning strategy in schools and point to the importance of guided retrieval practice in young children.

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### Working Memory Deficits as a Common Impairment in Schizophrenia, Bipolar and Borderline Personality Disorder.

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Introduction: Severe mental disorders, such as Schizophrenia (SCZ), Bipolar (BD) and Borderline disorders (BPD) have been associated with neurocognitive impairment. Some studies suggest that specific neurocognitive deficits predict long-term global functioning in patients with these disorders. A cognitive domain where impairment has consistently been observed is Working Memory (WM). While previous clinical research has shown WM impairments in people with SCZ and BD, WM functioning has been much less investigated in other severe mental disorders, such as borderline personality disorder (BPD). Material and methods: Hence, in the present study we compare the performance of 20 patients with SCZ, 19 with BD, 20 with BPD and 19 demographically matched healthy volunteers on two WM tasks (one requiring updating and other maintenance of information). Results: The results show that, relative to controls, the three psychiatric groups share a deficit in their ability to update WM but exhibit comparable abilities to maintain information in WM. Conclusions: These findings support the idea that SCZ, BD and BPD entail a common (and specific) impairment in updating WM contents and thus provide evidence for a similar cognitive substrate underlying poor cognitive performance in these three disorders.

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### Enlightenment Instructions Decrease the Acceptance of Central Misinformation.

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The presentation of misinformation may distort eyewitness memory and create false memories. However, not all false memories are similarly relevant. False memories about central items (e.g., the weapon used in an assault) are forensically more relevant than false memories about peripheral items (e.g., an unrelated object in the background). Several attempts have been made to try to reduce the negative effects of misinformation. For example, the enlightenment instructions try to ensure that participants have an adequate representation of the task and have been successful in reducing false memories. In this research we tested whether enlightenment may help to reduce the acceptance of misinformation for central items. Participants watched a short video about a bank robbery, completed a filler task, and received misinformation through a narrative. The narrative included four misinformation items, two central and two peripheral. Immediately afterwards one group of participants read the enlightenment instructions and another read standard instructions. Then, they completed a true/false recognition test that included both true items from the video and misinformation items from the narrative. Results showed that, for central misinformation items, enlightenment increased accuracy, measured with  $A'$ , but not for the rest of items. For central misinformation items enlightenment both increased hits and decreased false alarms, thus reducing the acceptance of false information. Results cannot be explained by a criterion shift. In general, our results support that enlightenment is a particularly useful procedure to reduce false memories for central items that are of particular relevance.

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### Cognitive Factors Underlying Memory Distortion Vulnerability.

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Cognitive psychology has assembled a massive amount of data leading to clear conclusion that people show tendency to create false memories (Loftus, 1975). Despite many years of research, crucial question about factors indicating individual's vulnerability to a memory distortion still remains unanswered. The issue of presented project was to examine cognitive factors causing individuals vulnerability to a wide range of memory distortions. The way people receive and proceed information and - as a consequence - memorize them (accurately or not), is known to be strongly related to basic cognitive abilities. To shed some light on this issue, three experiments using the DRM paradigm (Deese 1959, Roediger & McDermott, 1995) and modified version of "remember-know judgment" procedure (Tulving, 1985) were conducted and compared to the results participants achieved in a various kinds of WM tasks, measuring its storage and proceeding capacities (Oberauer et al., 2003 ; Oberauer, 2006).

It was assumed that high WM participants will create less false memories in DRM procedure, compared to poor ones (H1). They were also expected to be less willing to yield under the external influence (H3), defined as strongly suggesting feedback information

provided during the procedure. The aim of last study (E2) was to verify whether a high level of subjective certainty declared by participants due to memory traces – sense of remembering – will be connected with high accuracy and low number of false memories in DRM procedure.

It came out that individual differences in WM efficiency are deciding to establish whether person is willing to create false memories as well as internalize suggestion, yield to its content and change previously defined pattern of behavior (Ilies, Judge & Wagner, 2015; Engle & Kane, 2004). It was shown that high WM individuals are able to protect themselves from yielding, probably through high accuracy of original memory trace (Roediger et al., 2014). Study findings are interpreted in terms of global memory discrimination ability.

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### Recording of the Operator's Activity as a Method of Expert Knowledge Objectification.

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Introduction. A lot of authors noticed existence of experts in various fields of activity and their outstanding skills (Groot, 1965, Chase, Simon, 1983, Spender, 1995); however the cause of the phenomena is still unknown. The procedure of novice and expert comparison is most widely used (Sternberg, Frensch, 1992). But between novice and expert knowledge there are both quantitatively and qualitatively distinctions. To overcome that for our research we chose relatively simple motor activity – piloting of toy-helicopter through obstacles. Methods. There were two stages of the experiment. First – recording of learning process (for that used two cameras and eye-tracker), analysis of gathered data (SubCam method (Nosulenko, 2009)) and creation of training video. Second – verification of the effectiveness of videos. For that we vary type of video (1 – without video (control group), 2 – video without eye-tracking information), 3 – video with it). Participants - 30.

Hypothesis: 1) Training video is an efficient way for experience transfer. 2) Information gathered by eye-tracker will have significant impact on learning processes.

Results. Videos are an effective way to transfer objectified experience. Both groups, with eye-tracking information ( $U=751,5$ ,  $p=0,001$ ) and without it ( $U=896,5$ ,  $p=0,01$ ), that saw videos had a longer total time of piloting in compare to control group. But between experimental groups was not obtained significant differences ( $U1099,5$ ,  $p=0,3$ ).

Conclusions. 1) Training video is an efficient way for experience transfer. 2) Eye-tracker information does not help.

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### Cognitive Control and Prospective Memory Performance: A mediation approach.

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The majority of memory research, and research on its cognitive underpinnings has thus far focused on retrospective memory, or memory for things learned or rehearsed in the past. More recently, however, prospective memory, or the memory for future intentions, has become a major area of research. It is theorized that prospective

and retrospective memory may both rely on similar constituent parts such as working memory and selective attention; the relationship between these constructs and prospective memory is, however, significantly less clear than for retrospective memory. In this study we sought to further clarify the role that cognitive process play in prospective memory performance using a SEM approach that included monitoring as a mediating variable in addition to focal, non-focal, and time-based prospective memory task condition. Both WMC and selective attention were found to have independent relationships to prospective memory performance in the non-focal and focal conditions respectively, with selective attention alone contributing to the monitoring factor. Results suggest a monitoring component is important in both focal and non-focal conditions, and that the type of monitoring observed in this study is related primarily to proactive interference, and reflects participants' ability to disengage from no longer relevant stimuli.

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### Are Category Learning Judgments More Accurate After a Delay?

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Category Learning Judgments (CLJs) are metacognitive judgments about the likelihood of correctly classifying a target into its respective category on a final test. CLJs tend to be above chance at predicting future classification performance; however, they are far from perfect. Thus, in the present study, we investigated whether delaying between category learning and CLJs would improve judgment accuracy. Participants ( $N = 118$ ) were randomly assigned to make CLJs immediately following study, interleaved with study, or in a separate block from study. Participants were presented with exemplars from different categories along with a randomly assigned category name (e.g., beme, zade, tyfe). Judgments from each group were made immediately following each exemplar (immediate), during the learning phase but delayed by 4 exemplars (interleaved), or after all the exemplars had been presented they were presented again for judgments (separate block). Participants were then tested by assigning the category name to each exemplar. Surprisingly, delaying CLJs did not improve relative accuracy compared to immediate CLJs, indicating that delaying CLJs is not an effective way to improve accuracy. These findings are in direct contrast to judgments of learning for specific pieces of information, in which delaying judgments improves accuracy. Thus, other ways of improving the relative accuracy of CLJs should be investigated.

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### Behavioral and Physiological Assessment of a Within-Subject Cue Interaction Effect in Humans.

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Cue competition effects are critical predictions of associative learning theories. When two cues are presented together and followed by an outcome, they compete and one of them will result weakly associated with the outcome. The reliability of these effects with humans has been called into question. Human

experiments generally use judgmental dependent variables which cast difficulty for its comparison to those used with other animals. The main objective of this research was to provide data to support the robustness of cue competition effects in humans by employing behavioral and physiological dependent variables. Experiment 1 used a within-subject design in which participants were first exposed to a cue (A) followed by an outcome, and then to A in compound with a new cue (X) followed by the same outcome. In addition to these cues, a control cue (C) was presented unreinforced in the first phase and in compound with a new control cue (Y) in the second phase, followed by the same outcome. Finally, tests were conducted for X and Y. The task used was a variant of a conditioned suppression procedure implemented as a computer game. Experiment 2 used the same design but with the measurement of electrodermal activity. Visual cues (A, B, X and Y) were followed by an aversive tone. Response to X were lower than responses to Y at test in both experiments, thus showing cue competition and extending its generality to humans under a variety of task procedures.

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### Serial Position Encoding of Signs.

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Reduced short-term memory (STM) capacity has been reported for signs as compared to speech when items have to be recalled in a specific order. This difference has been attributed to a more precise and efficient serial position encoding in verbal STM (used for speech) than visuospatial STM (used for signs). We tested whether the reduced STM capacity with signs stems from a lack of positional encoding available in verbal STM. Error analyses reported in prior studies have revealed that for verbal material the positions within a sequence are defined by distance from both the start and the end of the sequence (both-edges positional encoding scheme). For the visuospatial material, however, the encoding scheme appears to be based only on the start of the sequence. If sign language material is encoded through visuospatial STM, we should expect the same results for signs.

We analysed the errors made by deaf participants in repeating sequences of signs, and we found that the STM representation of signs is characterized by the both-edges positional encoding scheme. These results indicate that the cause of the STM disadvantage is not the type of positional encoding but rather difficulties in binding of items in visuospatial STM to the specific positions in a sequence. Both-edges positional encoding scheme could be specific for sign language material, since it has not been found in visuospatial STM tasks conducted with hearing participants.

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### Stimulus-Classification Associations but Not Stimulus-Action Associations Are Subject to Top-Down Control.

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Recent studies have shown that, in contrast to traditional views of associative learning, S-R associations are not merely simple links between stimuli and responses acquired by their co-occurrence, but consist of two distinct components: Stimulus-Action (S-A) and Stimulus-Classification (S-C) associations. We have previously demonstrated that both S-A and S-C associations can not only be formed by application, i.e., response execution, but also by mere instruction and that instruction-based associations are retrieved even when they are goal-irrelevant. Here we examine (dis)similarities in terms of the automaticity of S-A and S-C associations formed by application and by mere instruction.

We used an item-specific priming paradigm in which stimuli appeared only once as a prime and once as a probe. S-A and S-C mappings independently repeated or switched between prime and probe instance. During prime trials, participants either applied these mappings or were merely instructed about them, whereas participants always responded in probe trials. To investigate the automaticity of the formed associations, we varied the relative frequency of repetition and switch trials to examine whether participants could use this on-the-fly acquired information to strategically adapt their responses.

Our findings clearly demonstrate that, whereas S-A associations are automatic, S-C associations impact on responding depending on the frequency of repetitions/switches, suggesting that S-C but not S-A associations are subject to top-down control. Crucially, we demonstrate that this holds true for both associations formed by application and associations formed by mere instruction.

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### On The Effect of Stress on Cognitive Failures in Everyday Life: A Look into Prospective Memory Errors.

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Stress is a strong modulator of memory functioning and it seems to produce diverse effects depending on the memory type under study. The rather scant research on the harmful effect of stress on prospective memory has yielded somewhat inconsistent results. The present study was designed to explore, in a population-based sample of healthy adults, the relationship between perceived daily stress and cognitive failures, namely, general cognitive failures and prospective memory errors. Participants completed a battery of self-report questionnaires, including the Perceived Stress scale, the Cognitive Failures Questionnaire, the Prospective and Retrospective Memory Questionnaire, three scales derived from the Memory Compensation Questionnaire, the Ego-Resiliency scale, and the General Health Questionnaire. In addition, all participants were administered an objective test of prospective memory, modeled after the Continuous Lab Measure of Event Cued ProM. Results indicated that stress was associated with more severe everyday cognitive complaints and both subjective and

objective prospective memory failures. Furthermore, high-stressed individuals complained more about psychological symptoms (e.g., anxiety, depression) and reported less resilience compared to low-stressed participants. The hierarchical regression model revealed that, besides stress, variance in prospective memory errors was also explained by age and individual differences in both negative symptoms and use of memory strategies. Moreover, these latter moderated the relationship between stress and prospective memory. These findings reinforce the view that everyday stress can be highly disruptive for prospective memory functioning and highlight the potential relevance of individual factors in modulating the harmful consequences associated to daily stress.

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### The Effect of Similarity in Personality Traits on Implicit Learning.

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The presence of others can influence memory and learning functions. Only a limited number of studies has investigated the social aspects of implicit learning so far. Our previous results suggest that social context could boost the consolidation of implicit learning. However, the exact mechanism underlying this improvement remained unclear. The present study therefore aimed to explore a possible factor, namely the effect of personality traits on this fundamental learning mechanism. Participants performed the Alternating Serial Reaction Time (ASRT) task in two sessions with 24 hours delay to measure implicit sequence learning. The task was administered in a social context where two participants completed the task in collaboration. Personality traits were measured with the Hungarian version of the brief Big Five Inventory (BFI-10). Participants filled in the questionnaire to assess both their own personality and that of the other. This provided measures reflecting the actual and perceived similarities in their personality traits. Our results show that the between-participant difference both in actual and in perceived extroversion predicts the implicit learning performance, with bigger between-participant difference leading to better implicit learning. These findings suggest that cognitive functions could be altered by social and trait factors, and the presence of others has a crucial role in encoding and consolidating memory traces. The observed effect of the context might contribute to develop more efficient educational methods and highlight the different cognitive resources to adapt to social situations.

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### Turning Semantic Into Episodic: Retrieval Practice Can Fixate Temporary Category Cue-Item Association Strengths.

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Retrieval practice can enhance learning but it might also induce forgetting of related memories (Roediger and Karpicke, 2006; Anderson, Bjork and Bjork, 1994). In two experiments, we investigated the long-term effects of practicing retrieval or study on

relative recall probabilities within a learning set. Subjects studied category-exemplar associations, some of which were then either restudied or retested. All memories were probed on a delayed final category-cued recall test. Using short (5 minutes) and long (5 and 10 days) retention delays between practice and final recall, we found that retrieval practice fixated the strength ratios within practiced category sets (strength ratio: the likelihood of retrieving a target exemplar in response to a studied category cue / numbers of studied exemplars). Contrary to retrieval, selective study changed strength ratios only for a short time interval, whereas longer delays reset strength ratios in comparison to baseline sets. These results can be interpreted in a theoretical framework describing retrieval practice function as an act of fixation of context-cue-item information in learning sets.

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### Visual Working Memory: Resolution and Subjective Visibility.

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It is hypothesised that we can increase the precision of the visual Working Memory (vWM) representation at a cost of lowering the number of items stored. Thus, if subjective visibility of a vWM content depends on the resolution then the task demanding higher precision should be associated with higher subjective visibility. Here, we used the cued change detection task with a complex stimuli (natural coloured objects). To manipulate the task demand, two conditions were introduced, one included the change of a whole object (Object condition, e.g. glass vs. banana) while the other, the change of a state of the same object (State condition, e.g. glass full vs. glass half empty). To ensure the same level of discriminative accuracy in both conditions, a staircase procedure with varying set size was deployed. To measure the level of subjective visibility the Perceptual Awareness Scale was used. The Object condition was associated with higher set size and higher level of subjective visibility than the State condition. The difference in the subjective visibility disappeared after correcting for the differences in the objective accuracy. The results indicate that it is possible to adjust the vWM precision according to the task demands. The question regarding the subjective visibility still remains open as we observed differences in the objective performance which might have biased the results. Future research is planned to investigate the relation between the resolution and the subjective visibility under one item condition varying the spatial cue timing.

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### Does Testing Insulate Against Proactive Interference? The Role of Expecting a Final Test.

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Proactive interference (PI) is regarded as one limiting factor for working memory capacity. Recently, some authors suggested that testing – that is, immediately recalling just learned information – insulates against PI. They found that memory performance in a given trial was better if stimuli from each previous trial were tested than if they were not. However, in these studies, the beneficial effect of testing on memory performance in a given trial cannot be

ascribed unambiguously to a PI-reducing effect of testing because participants expected a final test. In such a situation, participants are likely to engage cognitive processes to pursue long-term retention for the final test, and these processes induce interference as well – for example, by intentionally retrieving stimuli from previous trials during later trials. Testing potentially reduces this type of interference by providing explicit opportunities for refreshing stimuli for the final test. Accordingly, in situations in which participants expect a final test, testing does not only reduce PI, but also interference from processes engaged to pursue long-term retention. A better estimate of the PI-reducing effect of testing can be obtained if participants do not expect a final test. Therefore, I investigated the effect of testing on working memory performance under conditions in which participants expected or did not expect a final test. The results revealed that the effect of testing on memory performance was significantly larger if participants expected a final test, indicating that the PI-reducing effect of testing is probably smaller than suggested by previous studies.

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### Proactive Interference and Auditory Distraction Effects in Cued, Free and Serial Recall.

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Background unattended speech has a deleterious effect upon short-term recall. Prior literature suggests that the phonological and/or semantic content of the irrelevant speech influences correct recall and intrusion errors in cued and free recall, but has little impact upon serial recall. Consequently, current theoretical explanations of irrelevant speech distinguish between interference by content and interference by process. While these differences have emerged across experiments, there are no experiments where between-stream effects in these tasks have been directly examined. The aim of the current set of experiments was to use a proactive interference paradigm in which the content of the irrelevant stream reinforced either the target item, or a to-be-forgotten foil. All that differed across conditions was the recall demands: some participants were given cued recall instructions, some free recall instructions, and some serial recall instructions. In the initial experiments, between-stream priming effects were readily observed in cued and free recall, and in serial recall, depending upon the scoring procedure used. We argue that these item interaction effects are the default outcome of any short-term memory paradigm and are closely related to the speech production system.

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### Metacognitive Judgments Are More Accurate After Than Before A Decision.

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What are metacognitive judgments based on? Our previous work on metacognitive awareness in perceptual decision suggests that visibility judgments are more accurate when given after than





before discriminating the orientation of stimuli they relate to. Here we present the results of three experiments aiming to investigate the differences in prospective and retrospective metacognition accuracy in memory task. In Experiment 1 participants were asked to remember lists of words and then to recognize a previously presented word either before or after assessing how clear was their memory of this word. In Experiment 2 the procedure was the same, but participants assessed their confidence in correct recognition. In Experiment 3 participants were asked to recall a word that was presented before and started with particular letter. They also assessed their confidence either before or after the recall. The results of all experiments showed that although task performance accuracy correlated with metacognitive judgments in both conditions, this relationship was weaker when metacognition was assessed before recognition or recall. The results are in agreement with data showing that metacognitive judgments depend on post-decisional processing of information that might not be available at the time of decision (i.e. reaction time or error signal).

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### **Mind Wandering during Learning is Modulated by Individual Differences in Mastery.**

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This research investigates the idea that studying materials in one's own Region of Proximal Learning (RPL) may reduce mind wandering. The items that comprise a person's RPL, though, are thought to be different for different people. In particular, people who have mastered many of the to-be-learned items should have an RPL consisting of items that are more difficult than the items in the RPL of people who have mastered few of the to-be-learned items. We hypothesized that people with high degrees as compared to low degrees of mastery should also show different patterns of mind wandering when studying the same materials. In our experiment, participants were probed for their attentional state (i.e., whether they were 'on task' or 'mind wandering') while they studied English-Spanish word pairs that had been blocked by whether they were easy, medium, or difficult. Participants were later tested on their learning. Consistent with the hypothesis, the materials which elicited mind wandering was found to depend on the individual's level of mastery. High mastery participants mind wandered more when studying the easy materials whereas low mastery participants tended to mind wander more when studying difficult items. These findings suggest that part of the learning advantage that comes from titrating the difficulty of the to-be-learned materials to each individual's region of proximal learning may result because materials in this sweet spot tend to engage the person's attention and curiosity and offset their tendency to mind wandering.

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### **Example Classification as a Strategy for Learning Declarative Concepts.**

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Declarative concepts are abstract concepts denoted by key terms with short definitions of the meaning of the concept. The current

research focuses on the use provided examples and example classification to learn declarative concepts. Provided examples are often given to students by a textbook to further illustrate abstract concepts. For example classification, students are asked (rather than told) which concept each example illustrates. We predicted that students who classified examples would do better on an example classification posttest than students who studied provided examples due to indirect evidence from the testing effect literature (whereby example classification is functionally a form of practice testing) and theory of transfer-appropriate processing (as posttest performance depends on the overlap between the processes engaged during encoding and the subsequent task). In Experiment 1, students either restudied concept definitions, studied provided examples, or classified examples of declarative concepts. Students who studied provided examples outperformed students who either classified examples or restudied definitions on an example classification posttest. However, students who classified examples during study did not receive feedback indicating the correctness of their response. In Experiment 2, we added an example classification group that received feedback, with the expectation that this adjustment would boost performance on the posttest over studying provided examples alone. However, posttest scores between the example classification group with feedback was similar to performance in the provided examples group, indicating that testing was not as effective as expected in this context of learning declarative concepts. Email: Amanda Zamary, [azamary@kent.edu](mailto:azamary@kent.edu)

### **Neural Mechanisms**

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### **Common Neural Substrates for Memory and Motor Inhibition: Meta-Analytic Evidence.**

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Inhibitory control refers to a control mechanism that supports the ability to override prepotent responses if required by task goals. Evidence from neuroimaging studies suggests anatomical similarities across tasks that involve suppressing thoughts or actions. The current meta-analyses investigated potential common neural substrates underlying memory and motor inhibition using Activation Likelihood Estimation (GingerALE). The meta-analyses included fMRI data from four different paradigms: the Think/No-Think, Stop-Signal, Go/No-Go, and antisaccade tasks, all requiring active initiation or suppression of thoughts or actions. Conjunction analyses revealed overlapping cortical and subcortical activations between memory and motor inhibition, including the right dorso- and ventro-lateral prefrontal cortex (DLPFC; VLPFC), the supramarginal gyrus, and the basal ganglia. While the DLPFC and VLPFC have been repeatedly implicated in inhibitory control functions such as retrieval suppression and action stopping, they may interact with the supramarginal gyrus for attentional orienting when performing inhibition. Importantly, the basal ganglia may serve to integrate domain-specific information to gate goal-directed behaviour, given the intricate connections between the basal ganglia nuclei and their critical position in relation to multiple cortical and subcortical structures. The remarkable similarity between memory and motor inhibition suggests a supramodal inhibition process involving cortical and subcortical networks, despite the distinct types of content being controlled.

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### Neural Correlates of a Prospective Sense of Agency.

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Sense of agency (SoA) refers to the feeling that we are in control of our own actions and, through them, of events in the outside world. One influential view claims that the SoA depends on a retrospective matching between the expected and actual outcome of an action. However, recent studies have revealed an additional, prospective component to the SoA, related to action selection. The present study aimed to clarify the neural mechanisms of this prospective mechanism by means of event-related potentials (ERPs). Participants responded to imperative left/right arrow stimuli that were preceded by either a compatible or an incompatible subliminal prime. After a variable delay, action outcomes were displayed, and subjective agency ratings were collected. Results show that incompatible priming disrupted action selection, and led to a reduction in SoA over action outcomes, relative to compatible priming. ERPs revealed that signals associated with SoA emerged already at the time of the action. This indexed an action monitoring process that signalled disruptions in action selection, and was linked to a reduction in SoA. Later, outcome monitoring was also associated with SoA. Thus, replicating previous studies, we found that an unconscious influence on action selection processes can affect the conscious experience of agency. Moreover, taking advantage of the temporal resolution of ERPs, we show that action monitoring signals influence SoA prospectively, as they emerge long before the outcome is known. Furthermore, the influence of this prospective, fluency-based, component on SoA is independent from retrospective outcome monitoring.

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### Orthographic Sensitivity in Differentiating Chinese Characters: An ERP Study of L1 and L2 Chinese Readers.

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Radicals are sub-character units specific to the Chinese orthography. Second language (L2) Chinese reading requires learning orthographic rules related to radical position and form. This study identified the processing differences between first language (L1) Chinese readers ( $n = 23$ ) and L2 Chinese learners with alphabetic L1 ( $n = 21$ ) in four stimuli types that varied in orthographic legality-- real Chinese characters, pseudo-characters, items with illegal radical position, and items with illegal radical form (Table 1). Each group's ERP responses in a one-back repetition detection task were submitted to linear mixed-effects regression models. For L1 readers, items with illegal position elicited stronger P100 at left-hemisphere electrodes than pseudo-characters. A similar effect occurred at the N170 for L2 readers. Items with illegal radical form produced stronger N270 than pseudo-characters at right-hemisphere electrodes in L1 readers, but not in L2 readers. Real characters elicited a larger posterior N270 than all non-existing stimuli types in L1 readers, while real characters were not differentiated from pseudo-characters for L2 readers at the N270. Results suggested that while violation of radical position was detected very early, minor violation of radical form was tolerated prior to lexical

access. Neural responses to orthographic violations and subsequent lexical access were delayed in L2 readers relative to L1 readers, highlighting the importance of efficient orthographic processing in Chinese reading.

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### Weaker Functional Connectivity between Frontal and Posterior Regions is Associated with Better Statistical Learning.

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Statistical learning is a fundamental mechanism of the brain, which extracts and represents regularities of our environment enabling predictive processing during perception and acquisition of perceptual, motor, cognitive, and social skills. Previous studies have revealed competitive neurocognitive processes underlying statistical learning, but the dynamic interplay of the related brain regions has not yet been investigated. The present study aimed to fill this gap by investigating the functional connectivity (FC) networks that promote statistical learning. Thirty young adults performed a statistical learning task on two consecutive days (with a 24 hours long delay interval) while 64 channels EEG was acquired. The task involved probabilistic sequences, which enabled to measure incidental/implicit learning of conditional probabilities. Phase synchronization in different frequency bands was used to quantify FC between cortical regions during three equal length periods of the learning task, and also after consolidation, at the test phase. We found that better statistical learning was associated with weaker FC between frontal and posterior regions in slow (theta) and fast (beta) oscillations. These negative correlations increased as the learning progressed. Our findings provide evidence that dynamic antagonist brain networks serve a hallmark of implicit statistical learning.

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### Sensation and Perception

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### Reading Pain-Related Words Influences Aversive Response.

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A few recent studies suggest that processing pain-related words may enhance activation of part of the neural circuitry underlying pain and modulate its perception (Richter et al., 2010; 2014). Will mere reading of pain-related words elicit avoidance responses similar to the ones elicited by noxious stimuli? If so, pain-related words will elicit faster avoidance responses than pain-unrelated words, and such responses will be modulated by the degree of painfulness associated with each word. Twenty participants judged whether a visually presented word was positive (60 words) or negative (20



pain-unrelated, 20 physical pain-related and 20 psychological pain-related words). To induce a stimulus-centred perspective in approach/avoidance responses (Phaf et al., 2014), participants were instructed to use a central key as a starting point and to judge the word valence by pressing a button closer to the screen for positive words (approach) and farther from the screen for negative words (avoidance). Pain-related stimuli were selected from a database of 512 Italian pain-related words, rated for psycholinguistic, emotional and pain-related variables (Borelli et al., submitted). In the avoidance condition, release times were faster for pain-related than pain-unrelated words. Partial correlations revealed that pain-related variables modulate the avoidance response to pain-related words by speeding reaction times. Hierarchical regressions showed that pain-relatedness and valence affect response times independently of one another, even after the contribution of psycholinguistic variables had been taken into account. These results show that words conveying pain trigger behavioural responses at least in part similar to the ones elicited by real, nociceptive stimuli.  
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### Earlier and Later On the Back-Front Mental Timeline in Adults and Pre-School Children.

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It has been suggested that abstract concepts like time need to be grounded in concrete domains such as space that are accessible to direct experience. Accordingly, the concept of time is thought to be represented as mental timeline running from back/left (past) to front/right (future). Evidence for this notion comes from a number of empirical studies employing spatial arrangement tasks. In these studies, participants typically arrange pictures depicting temporal sequences according to their mental timeline. Moreover, when asked to make earlier/later judgements, participants respond faster when a left keypress corresponds to an earlier response and a right keypress corresponds to a later response compared to the reversed mapping. In the present study, we examined this space-time congruency effect for sequence judgements on the back-front mental timeline. Since it is still unclear when the mental timeline develops in children and whether it is necessary for an understanding of temporal succession, we tested adults as well as pre-school children in a picture sequence judgement task. Two pictures depicting a temporal sequence were presented successively and participants judged whether the second picture depicted an earlier or a later state than the first picture. Participants responded by making whole body forward or backward movements. Results show a clear difference between the space-time congruency effect on RT of adults and children. This suggests that the mental timeline is not yet fully developed in pre-school children although these children were able to make correct sequence judgements.

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### Ladies or Gentlemen: Effects of Mortality Salience on Product Gendering.

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Gender cues like colors of blue and pink can influence perception of the product along its warmth and competence, two commonly accepted dimensions of gender stereotyping and, consequently, impact the product evaluation. Little previous research has examined the effects of gender stereotypes on product perception in a situation involving mortality salience. Experiment 1 (N=103) of a one-way (mortality salience vs. control) between-subject design and Experiment 2 (N=145) in a 2 (mortality salience vs. control)  $\times$  2 (masculine vs. feminine product) between-subject design revealed that death-related thoughts have more negative attitude toward feminine-stereotyped products. This effect is further shown to be mediated by the perceived competence of the product, and moderated by consumers' locus of control by Experiment 3 (N=197) of a 2 (mortality salience vs. control)  $\times$  2 (internal vs. external control) between-subject factorial design. This study supports the conventional view that feminine cues from product perception enhance perceived warmth, yet the low-competence cue backfires when placed in a mortality salience context. The competence of the masculine product does appeal in a mortality salience context to bolster self-esteem, yet a choice decision between the masculine and feminine product, is more an avoidance of the weaker item than an acquisition of a strong item.  
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### Does Motor Preparation Influence Word Processing? Investigating the Functional Relevance of Experiential Simulations.

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Theories of embodied language processing state that people mentally simulate the described objects and events during comprehension. While there is ample evidence that these simulations do exist, it is still unknown whether they are actually needed to understand language or just an optional by-product. Most studies investigating simulations have shown an influence of linguistic processes on non-linguistic tasks. For example, participants respond faster to words referring to objects usually found in an upper or lower location in the world (up/down words; e.g., sun or worm) when word location and response direction match (e.g., upper location and upward movement). However, if simulations are functionally relevant for comprehension, we should also be able to find the reverse effect, namely that non-linguistic processes influence language processing. In the current study, we investigate verbal lexical decision times to up/down words, while participants prepare an upward or downward movement of the arm. Preliminary results (N = 18) show a significant interaction between the prepared response direction and the implied location of the word. Lexical decision is facilitated when movement direction and word location match. Preparing a response in a certain direction seems to have preactivated the associated location, thereby facilitating simulations of objects usually found in that location. This finding implies that simulations might indeed be functionally relevant for word comprehension.  
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**Disrupting Holistic Processing: Effects of Constraining Perceptual Field on Face Processing and Recognition.**GARY C.W. SHYI, VICKY Y.-H. CHEN, *National Chung Cheng University.*

Holistic processing has widely been construed as the core mechanism underlying face processing and recognition. In two experiments, we examined whether constraining perceptual field via gaze contingency would affect face perception as a consequence of disrupting holistic processing. In Experiment 1, we followed the procedure of gaze-contingent stimulation used by van Belle, De Graef, Verfaillie, Rossion, & Lefèvre (2010, JOV), where participants were asked to perform a matching-to-sample task in one of the three conditions, namely the full-view, mask, and window condition. Our results replicated van Belle et al.'s findings where the mask condition was minimally affected by gaze contingent manipulation and exhibited reliable inversion effect comparable to that in the full-view condition. In contrast, inversion effect was effectively eliminated in the window condition. In Experiment 2, we further examined how constraining perceptual field may affect different aspects of face processing. Specifically, participants were asked to compare faces that differed either in terms of components, configuration, or composition in both the full-view and window conditions. Results from the configural task revealed that inversion effect evident in the full-view condition was eliminated in the window condition. Likewise, for the composite task, congruency effect evident in the aligned full-view condition was eliminated in the window condition. In contrast, for the component task, while an inversion effect was also evident, it was not eliminated in the window condition. These findings together indicate that configural and holistic processing of faces can be effectively disrupted by constraining the perceptual field within which faces are viewed.

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CENTRAL HALL,  
FRIDAY 6TH MAY, 10:00-12:40  
POSTER SESSION II

**Animal Research**

(1)

**Basic Associative Processes in Earthworms: Latent Inhibition.**

M. JOSÉ F. ABAD, DAVID REYES-JIMÉNEZ and CONCEPCIÓN PAREDES-OLAY, *Jaén University*.

The study of invertebrate learning is an interesting topic in the field of animal learning and cognition that has been revitalized along the last years. In particular, the study of conditioning processes in invertebrates had provided useful information to the understanding of the physiological bases of learning and memory. Moreover, it is essential to understand the phylogenetic evolution of associative learning as basic mechanism of learning and survival. Our research is part of this proposal: the need of studying the associative processes in invertebrate species in order to get a global vision of comparative psychology.

In preliminary studies, we have showed different procedures of classical conditioning in earthworms (*Eisenia foetida* and *Lumbricus terrestris*), using a vibration or an odor as conditioned stimuli (CS) and a bright light as unconditioned stimulus. After training conditioning, the presence of these stimuli produced a withdrawal conditioned response. In this experiment we show the latent inhibition effect, that is, the effect produced by the preexposure of the stimulus that would be conditioned. The earthworms of experimental group were exposed to CS presentation before conditioning training while the control group hadn't this previous experience with the CS. Our results replicate the latent inhibition effect, that is, a decreasing of conditioning in the preexposed group. The implication of these results to the field of comparative cognition is discussed.

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(2)

**Predictors of Decision Making Across the Adult Life-Span: An Individual-Differences Study.**

FABIO DEL MISSIER, *University of Trieste*, TIMO MÄNTYLÄ, *Stockholm University*, PATRIK HANSSON, *Umeå University*, WÄNDI BRUINE DE BRUIN, *Leeds University/Carnegie Mellon University*, ANDREW M. PARKER, *RAND Corporation*, LARS-GÖRAN NILSON, *Stockholm University*.

Age-related decline in complex cognitive tasks has been explained by changes in sensory functioning, processing speed, and working memory. However, there is still no agreement on the relative importance of these factors, and their relative role in decision making has not been investigated. In an individual-difference study on a population-based Swedish sample of adults (N = 563, age range 30-89), we disentangled the contribution of sensory decline, processing speed, and working memory measures to age-related changes in three cognitively-demanding decision-making tasks of the Adult Decision-Making Competence Battery (Resistance to Framing, Applying Decision Rules, Under/Overconfidence).

Structural equation modeling showed that working memory is a significant predictor even when the influence of sensory variables, processing speed, and education (as a control for cohort effects) is taken into account. Moreover, the effects of sensory functioning and processing speed on decision making were mediated by working memory. These findings indicate that the age-related decline in complex decision-making tasks may not be entirely explained by changes in lower-level processes, highlighting the functional role of working memory processes.

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(3)

**Influence of Density and Environmental Constraints on the Shoaling Behavior of Two Species of Fish.**

ELISABET GIMENO, VICENÇ QUERA, FRANCESC S. BELTRAN, RUTH DOLADO, *University of Barcelona*.

In the scientific literature, there is a distinction between two main patterns of collective motion of fish: shoals, which are aggregations of individuals that show a significant degree of cohesion; and schools, which show a significant degree of coordination of the individual movements by the alignment of the individuals. We analyzed the collective motion of two social fish species, zebrafish (*Danio rerio*) and black neon tetra (*Hyphessobrycon herbertaxelrodi*), and we compared their patterns of movement by means of statistical global indexes. We also examined the effect of the density and some environmental constraints (water height and tank geometry) in the collective motion of both species. We recorded the spontaneous movement of groups of fish (N = 10 and 20) during 30 min, using two tank geometries: a rectangular shape and a rectangular shape with rounded corners; and we also manipulated the water height (15 and 25 cm). We randomly selected six video fragments of 25 s per each experimental condition, extracted the individual fish trajectories for each fragment, and calculated indexes of cohesion, coordination, and shoal shape. The ANOVAs showed that the two species had different types of collective motion: the zebrafish global motion matches that of a shoal, while the black neon tetras motion matches that of a school. Moreover, zebrafish were more sensitive to the environmental constraints, which suggests that the collective motion of schools is more robust than the motion of shoals.

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(4)

**“Shall I Stop or Shall I Go”: Response Inhibition in Pigeons.**

CHRISTINA MEIER, STEPHEN E. G. LEA, IAN P. L. MCLAREN, *University of Exeter*. Does the inhibition of a prepared behaviour require executive control? The cognitive flexibility to correct behaviour when it suddenly becomes inappropriate is seen as a hallmark of executive-control processes; this implies that only species possessing executive control should be capable of inhibiting behaviour after it has been initiated. Yet many species have to contend with a world of unforeseeable events

often requiring response inhibition. Do they all possess executive control? We trained pigeons to peck quickly at one of two keys of different colours to obtain a food reward. On 25% of trials, the rewarded key was replaced (after a varying interval) by a signal of a different colour. On these trials, in Experiment 1, pecking this signal had no effect, but pecking the usually unrewarded alternative key led to a reward, indicating that the response should be changed (Change-Signal task); in Experiment 2, pecking the alternative key still had no effect, but pecking the signal led to a timeout instead of a reward, indicating that a response should be withheld (Stop-Signal task). Pigeons were able to either change or withhold a response when signalled, but doing so became increasingly difficult with increasing stimulus-signal interval. This suggests that pigeons face difficulties inhibiting a response once it has been initiated, but nevertheless are able to do so, raising questions about the role of executive control.

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(5)

### Ambiguity Improves Acquisition of Positive Patterning in Human Predictive Learning.

A. MATÍAS GÁMEZ, *Universidad de Cádiz*, JOSÉ A. ALCALÁ, JUAN M. ROSAS, JOSÉ E. CALLEJAS-AGUILERA, *Universidad de Jaén*.

Attentional Theory of Context Processing (ATCP) suggests that context-dependence of the information is boosted by an increase on the attention contexts receive when the learning situation involves ambiguity. Recent research in our laboratory suggests that rats' spatial and temporal learning is improved after acquisition. The goal of the present experimental series was to test whether human predictive learning may be also improved by the ambiguity produced by an extinction treatment. Participants were trained in a predictive learning situation in which they learned that a given cue (food) was first followed by a given outcome (gastric malaise) in hypothetical customers of a given restaurant. Once participants learned this relationship, the cue-outcome association was either extinguished (by presenting the food without the gastric malaise) or not, depending on the group. Subsequent acquisition of positive patterning was improved after the extinction treatment, suggesting that ambiguity improves learning in humans the same way it seems to improve learning in animals, and that this improvement goes beyond the learning about contexts suggested by ATCP.

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### Attention and Performance

(6)

### The Effect of Response Mode on Cognitive Control Mechanisms.

RYEONG CHANG, YANG SEOK CHO, *Korea University*.

Many researches have been conducted to see if cognitive control mechanisms triggered by conflict are specific to response mode. Some showed that control processes operate on the link between the task-irrelevant stimulus dimension and response mode. On the other hand, sharing a control mechanism between two different tasks has nothing to do with the response mode. Specifically, Weissman and his colleagues (2015) showed evidence for the distracter head start hypothesis and found the congruency sequence effect between two tasks with different response modes. Our

goal was to replicate their experiment with a different task to see whether the cognitive control mechanisms triggered by conflict is specific to response mode. Participants were instructed to perform two prime-probe tasks alternatively, in which different pairs of color stimuli were used for each task, respectively. A pair of prime and probe could be shown simultaneously or sequentially. Participants responded to one task with their left hands and to the other with the right hands in Experiment 1, whereas they responded to one task with index fingers and the other with middle fingers in Experiment 2. No congruency sequence effect was obtained when the two tasks did not share response mode, which is inconsistent with the idea that the cognitive control mechanism triggered by conflict is response mode general. Thus, these results implicate that control mechanism can be affected by response mode and the boundary of cognitive control may not be clear, as some suggested. Email: Yang Seok Cho, [yscho\\_psych@korea.ac.kr](mailto:yscho_psych@korea.ac.kr)

(7)

### The Neural Process of Imitative Control.

CHIA-CHI CHOW, PASCO FEARON, PETER FONAGY, JAMES SHEFFIELD, *University College London*.

Previous fMRI research has indicated the functional-anatomical overlap between imitative control and the capacity to understand other's mental states, i.e. mentalizing. It is commonly argued that the temporo-parietal junction and the anterior fronto-medial cortex are recruited during these two activities and serve the same representational system. Two ERP components, TP450 and the late frontal slow wave (LFSW), are argued to reflect the computational processes during mentalizing. However, little work has addressed whether similar neural processes and ERP components are elicited during imitative control nor examined this capacity in adolescents. In this study, we used the imitation inhibition task with 38 adolescents (19 females, mean age = 16.21 ± 1.74), and measured simultaneous high-density EEG. Repeated measure ANOVA demonstrated that the peak latencies of TP450 were longer in the incongruent condition, and the peak amplitudes of the TP450 were larger over the right hemisphere. Meanwhile, the mean LFSW amplitude was more positive in the congruent condition compared to the incongruent condition. Correlational analysis showed a negative relationship between age and peak latency of TP450 at right hemisphere for both conditions. Moreover, only in incongruent condition, age was associated with the mean amplitude of LFSW at the left and right sites. These findings indicated that the neural processes for mentalizing capacity and imitative inhibition are overlapped in typically developing adolescents, and age effect should be considered in future research.

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(8)

### Appetitive Food Stimuli Narrow Attention and Improve Goal Shielding.

IRENA DOMACHOWSKA, HANNES RUGE, ANNETTE BOLTE, THOMAS GOSCHKE *Technische Universität Dresden*.

The control of visual attention during goal directed action requires focused attention on goal-relevant information and inhibition of distractors. The more desirable the goal (e.g. delicious food), the more focused attention it should elicit. Indeed, studies examining the attentional consequences of approach motivated affective states have shown that positive food stimuli resulted in more local



attentional focus than neutral stimuli, as measured with a Navon task (e.g. Gable & Harmon-Jones, 2008; Domachowska et al., 2016). In the current study, we used a visual search paradigm in which participants had to detect a target object (a house) among a set of context stimuli (tools). Presenting appetitive food pictures (compared to neutral pictures) before each search stimulus led to a narrowed attention breadth and improved goal shielding, as indicated by reduced reaction time costs on trials containing a salient but to-be-ignored face distracter. This suggests that appetitive affective-motivational states not only induce a local attentional focus, but also reduce interference from task-irrelevant information, presumably reflecting an increased attentional weighting of goal-relevant stimulus categories.

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(9)

### Top-Down Attentional Control Is Permeable to Reward-Based Modulation.

OSCAR FERRANTE, CHIARA DELLA LIBERA, ELISA SANTANDREA, LEONARDO CHELAZZI, *University of Verona*. In visual search the influence of inter-trial contingencies (whether target-distractors defining features stay the same or swap across consecutive trials) is modulated by reward. So far these effects were obtained with tasks wherein the influence of reward stemmed from its association with low-level stimulus features, such as color, shape or location. Here we tested whether reward can also impact top-down attentional control, i.e., the endogenous signals guiding selection at a more abstract (categorical) level of representation. At the start of each trial, participants were cued as to the relevant target category (numeral vs. letter). The subsequent multi-colored display contained both a numeral and a letter among distracters, and the participant indicated the color of the cued target. After each correct response, reward was delivered, which was high or low with equal probability. Performance was assessed as a function of the relevant target category across consecutive trials, as well as of the amount of reward received between consecutive trials. Crucially, we focused on cases where the critical items (numeral and letter) differed across consecutive trials. Results showed that performance was better when participants had to prioritize the same target category across consecutive trials, relative to when the category switched. Importantly, this effect was modulated by reward: high reward led to greater benefits from maintaining the same attentional set and greater costs from switching to the alternative set. Our findings demonstrate that top-down attentional control is permeable to the influence of reward, reflecting its dynamic adjustment on the basis of past outcomes.

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(10)

### More Efficient Visual Search Can Be Promoted By Low Loads of Working Memory for Target- But Not for Distractor-Related Search Features.

TERESA CAÑAS-BAJO, *The University of Edinburgh*, BEATRIZ GIL-GÓMEZ DE LIAÑO, *Universidad Autónoma de Madrid*, ANA CHICA, *Universidad de Granada*.

Recent research in Visual Search (VS) has shown that Working Memory (WM) load can promote more efficient searches under certain conditions. Among others, one of the factors modulating

this effect relies on the relationship between memory contents and information playing the role of distractors or targets in the search. However, the way that the control condition has been manipulated in these studies by pre-exposing WM contents (just showing the same items as in the WM condition, but not to be remembered), has made results difficult to interpret (Smilek et al., 2006, Gil-Gómez de Liaño et al., 2011). In four different experiments, we manipulated WM contents by showing information maintained in WM playing the role of distractors (experiments 1 and 2) or targets (experiments 3 and 4). Also, pre-exposition (experiments 2 and 4) and no-pre-exposition (experiments 1 and 3) in the control conditions was studied to rule out previous confounding results. Our results in fact rule out a role of pre-exposition. Interestingly, there was more distractor interference in visual search when “target” is loaded in WM than when “distractors” are, but more importantly, there is a modulation of the amount of load only when target information is maintained in WM: there is less distractor interference under (target) low load conditions, while distractors interference is bigger under (target) high load conditions. The results show that only certain amount of load related to target-search-features promotes less distractor interference in VS, explaining several differential results found in the literature.

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(11)

### Effects of Cognitive Exhaustion on Three Types of Attentional Conflict.

JULLIAN HERNANDEZ-PUMAREJO, *University of Granada*, MARCIN BUKOWSKI, *Jagiellonian University*, ALBERTO ACOSTA, JUAN LUPIÁÑEZ, *University of Granada*. Several lines of research have established that prolonged cognitive effort, without gain, can exhaust individuals to the point that they are no longer willing or able to undertake such efforts in the immediate future. A recent study about the limits of control and the effects of uncontrollability on attentional control now provides evidence that cognitive exhaustion can be detrimental to attentional control. The present study seeks to further elucidate upon the relationship between cognitive exhaustion and executive functions by determining whether these detriments are domain-general or domain-specific. To accomplish this, we randomly assigned eighty participants (mean age = 22.37) into either a control-exhausted or a control-exerted group. To induce exhaustion we used the Informational Helplessness Training procedure where a set of discrimination problems are either solvable (i.e., exerted group) or unsolvable (i.e., exhausted group). Subsequently, all participants performed an attentional control task composed of three different types of conflict: a) irrelevant distractor interference, b) Simon interference, c) spatial Stroop interference. Our results show that although both groups performed similarly in diminishing irrelevant distractor interference, the detrimental effects of cognitive exhaustion are not in fact domain-general, but rather domain-specific, as those in the exhausted group had greater Simon interference and less to none interference in the spatial Stroop. These results are discussed within the framework of motivational influences on executive control.

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(12)

### Attentional Allocation to Template-Matching and Nonmatching Objects in Visual Search.

MICHAEL JENKINS, ANNA GRUBERT, MARTIN EIMER, *Birkbeck, University of London.*

Attentional templates for known target features control the allocation of attention to targets during visual search. We investigated the time course of attentional object selection when a template-matching object is no longer task-relevant and a different object has to be selected instead. All search displays contained an object in a known fixed colour (T1). In One-Colour trials, T1 was presented among three grey nontargets. In randomly intermixed Two-Colour trials, T1 appeared together with an object in a different unpredictable colour (T2) and two grey items. Participants had to report the identity of T1 in One-Colour trials, but to ignore T1 and report the identity of T2 in Two-Colour trials. The N2pc component of the event-related potential (ERP) was measured to track the deployment of attention to T1 and T2. In One-Colour trials, the N2pc to T1 emerged 180 ms post-stimulus, reflecting the rapid attentional selection of template-matching targets. In Two-Colour trials, N2pc components to T1 and T2 were triggered simultaneously, but the N2pc to the now irrelevant template-matching T1 was attenuated. The N2pc to T2 targets in Two-Colour trials was delayed relative to the N2pc to T1 targets in One-Colour trials. Results demonstrate that when a template-matching nontarget and a target in a different unpredictable colour are present in the same display, attention is allocated to both objects in parallel. Competition between these two objects is biased towards the target, but target selection is delayed relative to trials with a single template-matching target object.

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(13)

### Inhibitions of Return: Two orienting biases.

RALPH S. REDDEN, RAYMOND M. KLEIN, *Dalhousie University.*

Inhibition of return (IOR) is usually viewed as an inhibitory aftermath of visual orienting typically seen in the form of slower responses to targets presented in a previously attended location or object (Posner & Cohen, 1984; Posner et al., 1985). Using the diagnostic patterns obtained when peripheral onset or central arrow targets are used, we have seen that there are two forms of inhibitory aftereffect: one caused by a peripheral stimulus whereby the effect is to decrease the efficiency of subsequent visual processing in the proximity of this stimulus (input effect); the second caused by oculomotor activation whereby the effect is a motor bias (output effect). These are distinguished clearly by whether the effect can only be measured by peripheral targets (input form when the reflexive oculomotor system is suppressed) or by whether there are roughly equivalent delays in response whether the targets are central or peripheral (output form when the reflexive oculomotor system is not suppressed). When performance is represented in speed-accuracy space the input form is manifest as a shift from one speed-accuracy tradeoff function to a less efficient one representing degraded or delayed processing of cued targets while the output form entails no shift in the function, but instead a movement along it (a response bias). Both forms bias orienting and hence can perform the novelty seeking function attributed to the inhibitions in the seminal papers: the input form does so by biasing perception, whereas the output form does so by biasing action.

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(14)

### Opportunities and Consequences of Interrupting a Low-Priority Task Response on the Processing of a High-Priority Task.

STÉPHANE IBRAHIME, *Université Paris-Saclay*, FRANÇOIS MAQUESTIAUX, *Université Bourgogne Franche-Comté*, ERIC RUTHRUFF, *University of New-Mexico*, MICHAËL PHOMSOPHA, *Université Paris-Saclay*, ANDRÉ DIDIERJEAN, *Université Bourgogne Franche-Comté and Institut Universitaire de France.*

In many real-world dual-task scenarios, such as driving while talking, one task (driving) is much more important than the other (talking). Can we appropriately prioritize the important task even when the other task is performed more often? To investigate this question, forty participants performed single-task and dual-task conditions mixed together within blocks. In single-task condition, participants responded to a visual stimulus with the left hand (low-priority task) as fast as possible. In dual-task conditions, the visual stimulus was followed by an auditory stimulus after a variable stimulus onset asynchrony ranging from short (e.g., 150, 300 ms) to long (e.g., 750 or 900 ms). When the tone (corresponding to the high-priority task) sounded, participants were encouraged to abort the low-priority task. Dual-task trials occurred on either 20% or 80% of all trials (a between-subjects variable). The results show that the second, high-priority task suffered a dual-task slowing even though participants were told to prioritize this task and were allowed to abort the low-priority task. This happened regardless of whether participants actually did abort the low-priority task or not. Also, the high-priority task was slower when dual-task trials occurred more rarely (i.e., on 20% of trials). These findings suggest that stopping a low-priority task does not necessarily immunize processing of a high-priority task against slowing. However, participants' preparation level seems to modulate the extent of this slowing.

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(15)

### The Role of Central Executive in Altering Multitask Situations.

JAAKKO KULOMÄKI, *Finnish Defence Research Agency*, LAURI OKSAMA, *National Defence University/Academy of Finland*, ESA RANTANEN, *Rochester Institute of Technology*, JUKKA HYÖNÄ, *University of Turku.*

Alteration of subtask priorities is an essential feature of real-life multitasking. Rapid reallocation of attention is required in adapting to the ever-changing task priorities in pilot's or driver's operational environment, for example. How good are we in this kind of reallocation? A quick readjustment of attention allocation requires an active central resource, which guides our attention in a rational manner to the currently relevant task features. However, some researchers have recently disputed the active role of central executive during multitasking (e.g. proponents of threaded cognition). In present study, we examined the reallocation of attention during a demanding monitoring task consisting of four or six subtasks (visual indicators). We compared a condition in which task priorities changed continuously requiring rapid reallocation of attention to a condition where task priorities remained constant.





We reasoned that performance improvement during the changing priorities condition gives evidence of an active central resource, that is, an active reallocation of attention. Subtask events were presented at the rate of 0.52 Hz to 68 participants (Experiment 1), at 0.70 Hz to 71 participants (Experiment 2) and at 0.60 Hz to 78 participants (Experiment 3). A discernible performance improvement was observed during the changing priorities condition in all three experiments. The effect was strongest at the event rate of 0.70 Hz. This suggests that central resource tends to allocate attention in an active and rational manner during multitasking situations.

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(16)

### **The Reference-Back Task: Separating the Contribution of WM Updating, Automatic Updating, Matching and Gating to N-back Performance.**

RACHEL RAC-LUBASHEVSKY, YOAV KESSLER, *Ben-Gurion University of the Negev*.

According to the gating model (O'Reilly & Frank, 2006), the content of working memory (WM) is controlled through a selective gating mechanism. Information in WM is robustly maintained when the gate is closed, while opening the gate enables updating, namely adding new items to WM or modifying old ones. The goal of this study was to separate the contribution of controlled, gate-dependent updating to performance in the n-back task. To do so, we used a newly-designed *reference-back* task. This variant of the n-back task is composed of two types of trials: *reference trials* which require both matching (i.e., a same/different judgement) and WM updating, and *comparison trials* which require only matching. This task enables separating the contribution of the matching decision, of automatic updating, gate-switching and WM updating to task performance. Ninety participants performed the following tasks: 2-choice RT, 1-back, 2-back and the reference-back task. A multiple regression approach was taken in order to explain individual differences in 1-back and 2-back by individual differences in the mentioned sub-processes, which were extracted from performance in the reference back task. The results indicate that RT in both 1-back and 2-back is mainly predicted by gate opening (namely, the cost of switching from comparison to reference trials) and by WM updating. Furthermore, results of the reference-back provide new behaviour support for the gating mechanism as seen by the significant switching cost between the two trial-types of the task. The implications of the results on the use of the n-back task are discussed.

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(17)

### **Speed-Accuracy Trade-Offs in Inhibitory Control Tasks.**

SOLVEIGA VIVIAN-GRIFFITHS, CRAIG HEDGE, PETROC SUMNER, *Cardiff University*. Strategic adjustment of behaviour has been widely investigated in psychophysics and memory, but only few studies (e.g.: Wylie et al., 2009; Leotti and Wager, 2010) have investigated how strategic speed-accuracy trade-offs affect performance in response inhibition tasks. This study investigated whether individuals' change of responses under different speed-accuracy demands in multiple inhibitory control tasks are stable across time and across different tasks. 56 participants performed Eriksen-Flanker and Stroop tasks. Task instructions and feedback were varied to emphasize speed, accuracy, or both. 47 participants

repeated the tasks a month later. Alongside expected congruency effects (higher RT times and error rates for incongruent trials than congruent trials), participants made most errors and performed the fastest under speed instructions than under accuracy instructions in both Flanker and Stroop tasks. Moreover, the difference in performance under speed and accuracy conditions correlated between the two sessions and between tasks. This provides evidence to suggest that individuals change their inhibitory behaviour under varying task demands, that this adaptability is stable in time and could be stable between different response inhibition tasks.

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(18)

### **Response Motor Actions Affect Attentional Control.**

KAZUHITO YOSHIZAKI, YURINA WATANABE, KIMIKO KATO, *Aichi Shukutoku University*.

A number of research has focused on the bodily states their effects on affective and cognitive processes (Friedman & Förster, 2008). We investigated the relationship between approach/avoidance motor actions and cognitive control. In a stimulus-response compatibility task, trial-by-trial context modulates the congruency effects, reflecting cognitive control. Specifically, the congruency effect is larger when it is preceded by a congruent trial than when it is preceded by an incongruent trial (Gratton effect). This effect is explained by conflict monitoring model (Botvinick et al., 2001), assuming that when detecting the potential conflict for ongoing information, the coming conflict is resolved by recruiting attentional resources for top-down information processing. Meanwhile, Förster et al. (2006) argued that performing arm flexion broadens, and performing arm extension narrows the scope of attention. Taken together, it is predicted that when the execution of arm flexion and the experience of the congruent trial, the congruency effect is larger in the next trial, resulting in a larger Gratton effect, compared with the execution of arm extension. To test this hypothesis, participants performed a typical Simon task by two types of response action manner; while in the arm flexion condition, they responded to targets by pressing a button located underneath a desk using their palms, in the arm extension condition, they responded to targets by pressing a button located on a desk with their palms. The results showed that Gratton effect was larger in the arm flexion than in the arm extension, suggesting that approach/avoidance motor actions affect attentional control.

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(19)

### **Executive Control in Bilinguals: The Role of Switching Frequency.**

SEOK HUI OOI, THOMAS BAK, ANTONELLA SORACE, *University of Edinburgh*. Some studies have suggested that bilinguals demonstrate better executive control than monolinguals in tasks requiring conflict resolution or inhibition of automatic responses. However, it is still unclear how the various factors associated with bilingualism influence executive functions.

We investigate how bilingual groups who differ on how frequently they switch between their

languages perform on the Attention Network Task (ANT) and the Elevator subtest of the Test of Everyday Attention. A total of 157 university students (40 English monolinguals, 49 non-switching

Edinburgh bilinguals and 68 high-switching Singapore bilinguals) were tested

( $M_{age} = 21.9$  years,  $SD_{age} = 3.6$  years). Both bilingual groups spoke English as their first language and were proficient, regular users of a second language as indicated by responses on the language background questionnaire.

Between-group ANOVA revealed that the bilinguals who engaged in frequent switching showed a smaller conflict effect on the ANT as compared to both monolinguals and bilinguals who did not switch between their languages. In addition, they were also faster to respond as indicated by shorter overall reaction times. In contrast, on the Elevator task, non-switching bilinguals outperformed both frequent-switching bilinguals and monolinguals in the Distraction subtest. The results suggest that bilingual switching frequency may differentially impact executive control processes employed in different cognitive tasks.

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### Complex Cognition

(20)

#### A Comparison of Causal-Conditional-Reasoning Models.

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Much research has been focused on how people assess the validity of logical arguments that include conditionals (if p, then q). For example, in Modus Ponens (MP) arguments, participants typically conclude from the conditional (if p, then q) and the affirmation of the antecedent (p), that the consequent (q) must logically follow. Some authors argue that when the conditional includes causal content, the estimated probability of the consequent (q) equals the conditional probability  $P(q|p)$ . In Bayes-net models, conditional probabilities are computed based on mental representations of the base rate and causal power of the antecedent and of alternative causes. We propose a different view of causal conditional reasoning in which participants focus on the causal link between the antecedent and the consequent while assuming that alternative causes are absent. We tested a formal model of this hypothesis against two Bayes-net models. To that end, separate groups of participants provided probabilistic judgments for MP and affirmation of the consequent (AC) arguments, as well as estimates of the model parameters. Although the correlation between Bayes-net predictions and conditional-reasoning judgments was high, the predictions overestimated the judgments. In terms of correlations, our own approach predicted the judgments about equally well as the Bayes-net models but was much less biased. We conclude that participants interpret logic arguments including causal conditionals as a request to focus on the causal relationship between the antecedent and the consequent, not the conditional probability of one given the other.

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#### Developmental Changes in Concept Typicality.

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The development of concepts throughout childhood was examined. For eight semantic categories, four at a subordinate level and four at a basic level, typicality ratings were collected for ten members and five non-members. In total, four age groups performed the

typicality judgement task: nine-year-olds ( $n=21$ ), eleven-year-olds ( $n=29$ ), thirteen-year-olds ( $n=12$ ) and adults ( $n=22$ ). In a separate study, we elicited features from different age groups for each of the categories. On the basis of these features, and applicability scores (indicating the applicability of features to the 15 exemplars of each category), different methodologies were applied to predict the typicality ratings in the different age groups to chart developmental changes. In particular, we calculated family resemblance measures, and used a geometric prototype model of typicality to account for the typicality ratings in each age groups. In this way, we were able to chart the evolution of the typicality gradient, and for each of the concepts as a function of age. As features were generated by children of various ages, we were also able to explore the relationship between the perception of similarity at different ages and the typicality gradient. We observed that while younger children's typicality ratings are more erratic and less consistent, they become more consistent and closer to adult's ratings as children get older. Results of the modeling and the specific tendencies across age groups are described in more detail.

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#### The Perceptual and Motor Properties of Concepts and Their Survival Relevance.

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Perceptual and motor properties of the concepts are important components of their representation and it could be argued that some specific properties can be more relevant in terms of survival than others. Amsel, Urbach and Kutas (2012) provided ratings of 559 object nouns on seven attributes (color vividness, visual motion, sound intensity, smell intensity, taste pleasantness, graspability and likelihood of pain) and uncovered two primary dimensions that can be interpreted as relating to survival. With the aim of extending these findings, a normative study ( $N = 196$ ) was conducted to collect ratings of those seven object attributes for a set of 250 Spanish concrete nouns. A principal-components analysis (PCA) with varimax rotation, including scores obtained for the seven dimensions, showed two factors which explained 33.3% and 29% of variance, respectively. These results are similar to those obtained by Amsel et al. and factors can be interpreted similarly. Factor 1 (avoiding death) includes loud objects, potentially harmful, likely to be in motion and unlikely to be grasped. Factor 2 (locating nourishment) includes objects with good taste, vivid colors and a strong smell. We correlated the attribute ratings with other psycholinguistic variables: emotional ratings, processing speed, subjective age-of-acquisition, body-object interaction, sensory experience ratings, familiarity and danger for human survival. Results are in line with an adaptive explanation. This study adds evidence to the idea that some properties of the objects have a special survival relevance and contributes to understanding how human cognition is importantly affected by survival aspects.

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### How Do Linguistic Features of the Task Determine Problem Solving?

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This work is a study of solving of text-problems. We suppose that solving a text problem depends on a correct interpretation of key concepts in this text. Key concepts are central objects of the situation represented in the problem. Solvers face difficulties when key objects have 2 different meanings and they chose the one which is inappropriate to situational model of particular problem, but is more likely to use an everyday life. For example concept "water" is represented in our mind both as "ice" and "running water". Solvers need to interpret "water" as "ice", which makes situational model complete and understanding of solution becomes clear. In our preparatory study we found out that subjects evaluate different ways of interpretation of concepts as more and less probable. This gave the opportunity to highlight 2 types of text-problems. We called them "1-way-complicating" and "ambivalent-complicating". Using a method of semantic priming was as the research method we tried to find differences between these 2 types of problems. We measured time, quantity of answers, "insightness" of a problem presenting questionnaire to subjects after solving. The results showed that subjects tend to solve the "ambivalent-complicating" problems faster. Effect of priming has not been revealed - a significant difference in time solving problems, depending on the sort of priming is not revealed. Each problem has its own "insightness", feature which determines time needed to solve the problem and quantity of wrong answers.

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### Cognitive/Learning and Social/Personality Predictors of the SAT, SAT-V, and SAT-M.

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Currently performance on the SAT, SAT-V, and SAT-M has been explained in two ways: (i) that SAT performance can be best explained by a collection of cognitive/learning and social/personality (i.e., C/L+S/P) factors (i.e., working memory, knowledge integration, test anxiety, performance avoidance, epistemic belief of learning) and (ii) that SAT performance can be best explained by measures of intelligence (e.g., Cattell's Culture Fair Test). The present study pitted these two views against each other. One hundred and seventy-one students completed measures of working memory, knowledge integration, test anxiety, performance avoidance, and epistemic belief of learning and their performances on these measures were used to predict SAT, SAT-V, and SAT-M performance. Exploratory factor analyses revealed three factors, namely a general cognitive ability factor, a performance avoidance-anxiety factor, and a belief about learning factor. Subsequent structural equation models (i.e., SEMs) revealed that: (i) the best theoretical model of the SAT included both the general cognitive ability and the performance avoidance-anxiety factors, (ii) the best theoretical model of the SAT-V included the general cognitive ability factor and the measure of performance avoidance, and (iii) the best theoretical model of the SAT-M included both the general cognitive ability and the performance avoidance-anxiety factors. These findings indicate that any theory about the composition of the SAT should consider the inclusion of both g-loaded cognitive

and non-g-loaded cognitive/learning and social/personality factors.  
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### Other-Race Categorization Advantage in a Binary- vs. Ternary-response Race Categorization Task.

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When categorizing a face based on race, people often respond faster to other-race faces than own-race faces [Other-Race Categorization Advantage (ORCA)]. The present study reported six experiments to explore the ORCA in Chinese participants in race categorization tasks with Caucasian, Indian, and Chinese faces. Participants either classified a face as Chinese vs. foreigner (binary-response categorization) or classified a face as Caucasian, Indian, or Chinese (ternary-response categorization). Experiments 1A (N = 23, age range 18-24) and 1B (N = 22, age range 18-24) presented faces of all three races in ternary-response and binary-response categorization tasks, respectively. The ORCA was observed in a binary-response task but not in a ternary-response task. Experiments 2A and 2B (N = 26, age range 17-26) were similar to Experiment 1A and 1B, except that the face stimuli were only involved internal features (e.g., eyes, nose, and mouth), and a same group of participants completed the two experiments. Again, the ORCA occurred in the binary-response categorization task, but not in the ternary-response categorization task. These results indicate that ORCA may result only from a fast and automatic processing but not from a slow and controlled processing.

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### Deactivating of Monitoring Control at the Stage of Impasse as Insight Solution Mechanism.

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The role of monitoring control in insight solution seems debatable. There are evidences it's important for insight solutions and the ones it's harmful for it. We believe that the most important is to disable monitoring control at the stage of impasse. We used tasks with matches (insight/regular). In the experiment subjects solved two types of tasks. 10/20 seconds after the task presentation we gave them the additional one (insight/algebraic). Interruption of solving after 10 seconds accelerates solution. Interruption after 20 seconds has no effect on the rate of solution. Solving algorithmic tasks requires executive control that obstructs insight solution. We expected that interruption of insight tasks will not affect solution rates. It works only if subject get an additional task after 20 seconds. Perhaps it takes 10 seconds to reach the impasse. An additional task overloaded controlling system and the main task was solved faster; interruption after 10 seconds prevents erroneous representation that obstructs solution finding. Maybe interruption at the proper time (10 seconds) prevents fixing on irrelevant task components. These versions refine the model of specific insight mechanism. We can suggest that one of mechanisms is deactivating processes of conscious control at the stage of impasse, which helps subject to escape inadequate algorithm and fixing on irrelevant task components.

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### Ad Hoc Categorization Effect and Standard Categorization Effect Competing In a Categorization Task: An ERP Study.

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Standard categories are based on learning properties of things (furniture, clothe, mammals, etc.); while ad hoc categories are constructed in the presence of an impromptu goal (things to sell at a charity event, etc.). While standard categories have well-established representations in memory, ad hoc categories involve a particular set of elements that rarely have been previously processed as related (Barsalou, 1983). We designed two experiments using event-related potentials (ERPs) to test whether the N400 component was modulated or not by an ad hoc categorization effect in comparison to the standard categorization effect. In Experiment 1, participants ( $n=28$ ) categorized words according to an ad hoc category ("To evaluate if the next objects fit in a *pencil-case*"). In Experiment 2, participants ( $n=23$ ) categorized words according to a standard semantic relation ("To evaluate if the next words are related with a *pencil-case*"). Words were orthogonally manipulated according to their ad hoc congruency/incongruence (AhC/I) and their standard congruency/incongruence (StC/I), resulting in 4 experimental conditions: AhC-StC ("an eraser"), AhC-StI ("a pea"), AhI-StC ("a school") and AhI-StI ("a toboggan"). Words were exactly the same in the two experiments, and they were matched for frequency, length and number of neighbors. In Experiment 1, Ah-C and St-C words showed less negative N400 amplitudes than Ah-I and St-I targets. In Experiment 2, only the standard semantic categorization effect emerged in the N400 (less negative amplitudes for congruent words). These results demonstrate for the first time that the N400 component is sensitive to ad hoc category effects.

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### The Importance of Fatigue Cognitions in Chronic Hepatitis B Infection in 2 Referral Center of Hepatitis in Iran.

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**Introduction:** Chronic Hepatitis B virus (HBV) infection is a source of significant public health burden worldwide. Fatigue is a cardinal patient reported consequence of the disease. HBV infection associated fatigue leads to significant impairment in the quality of life and day-to-day functioning. Despite its clinical significance, the factors that contribute to adverse impact of fatigue in HBV infection are largely unknown. This study evaluated the contributions of insomnia, depression symptoms, and fatigue-specific cognitions to fatigue-related functional impairment.

**Methods and materials:** Fatigue, insomnia, depression symptoms, as well as fatigue cognitions were assessed in participants (45% females; age >24 years,  $N = 100$ ) with chronic HBV infection at two referral center of hepatitis clinic in Kerman and Tehran, Iran.

**Results:** 70% of participants reported clinically significant fatigue

(Fatigue Severity Index  $FSS \geq 4$ ). Comorbidities and fatigue perceptions accounted for 71% of the variation of fatigue. Fatigue perceptions were the main predictors of adverse fatigue outcomes ( $B = 114$ , 95% CI = .054-.154). Patients with clinically significant fatigue were three-times more likely than less fatigued patients to believe that the main cause of their fatigue was the infection.

**Conclusion:** Patients' beliefs about their fatigue were the main predictors of adverse fatigue outcomes. These results suggest that fatigue associated with chronic hepatitis B infection can be conceptualized using a cognitive behavioral approach.

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### Solving Complex Problems Requires Stable Performance.

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Mean reaction times (RT) and the intra-subject standard deviation of RT in simple RT tasks have been shown repeatedly to predict higher-order cognitive abilities measured with psychometric intelligence tests (Jensen, 1992), thus emphasizing the relevance of processing speed and intra-subject variability for individual differences in intelligence. To precise this relationship, we modelled RT distributions using diffusion and ex-Gaussian models. Different simple choice-reaction time tasks and Cattell's Culture Fair Intelligence Test (CFT-20R) were administered to a sample of  $N=277$  children and adolescents aged 8-18 years (46% male). Different parameters derived from applying Ratcliff's diffusion model (fast-dm; Voss & Voss, 2007) and an ex-Gaussian model (GAMLSS package for R) to the age-residualized RT data were used to predict fluid intelligence scores using structural equation modelling (SEM). All SEMs exhibited a good to excellent model fit. The drift rate parameter of the diffusion model ( $\beta = .38$ ), as well as sigma of the ex-Gaussian model ( $\beta = -.43$ ) showed significant and substantial predictive validity regarding fluid intelligence. Our findings show that stability of performance more than its mere speed is relevant for fluid intelligence and endorse the view that individual differences in complex problem solving can be partially explained by the intra-subject stability in speeded information processing.

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### Biofunctional Mutual Exclusion: An Embodiment Process to Creating Meaning in Language and Metaphor.

CATANYA G. STAGER, ASGHAR IRAN-NEJAD, *University of Alabama*.

Research evidence has been increasing for psychological understanding to be considered an embodied, biological process, one that points to the role of the nervous system in categorizing sensorimotor knowledge. Therefore, to better grasp the biological nature of embodiment and its role in meaning making in language, researchers interested in such constructs as embodiment and embodied cognition should look to the role of biological processes. One such process has been called biofunctional mutual exclusion (BME) and recognized in studies on surprise-ending stories and





positive and negative affect. We review the current interdisciplinary literature to show the evidence BME is a biological meaning making process, a robust topic that very few investigators have sought for its fundamental implication within cognitive science. In this review of the literature, we highlight the phenomenon of BME as a fundamental process applicable to not only to affect but also to language learning (termed mutual exclusivity), natural categories, and metaphor understanding by indexing the research base in biology and psychology. By analysing research across disciplines, we review, index, and categorize research studies which include elements of the sensorimotor categorization and other biological systems in categorization of concepts. Based on this indexing system, we present evidence that indicates BME contributes to categorization in creating meaning in these cases. Outlining the BME process in the meaning making in light of a biologically embodied process expands the depth for studying the development of understanding.

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### Domain-Specific Cognition

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#### The Effect of Angry versus Fearful Facial Expression on Decision Making Processes.

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Fearful facial expressions differ from angry faces in terms of their information value (Whalen, 1998). For instance, a fearful expression may divert attention to the context as it signals the existence of a potential threat in the surrounding environment, whereas an angry face, as a source of the threat, may attract the attention of the observer (Davis et al., 2011; Williams et al., 2005). Although this explanation has been tested on early visual perception, attention, and memory processes, it has been not assessed on other cognitive domains. The purpose of the present study is to investigate the effects of different facial expressions contrasting in terms their informative value (i.e., angry faces versus fearful faces) on decision making processes. By using the Iowa gambling paradigm (IGT; Bechara et al., 1994), we expected that preceding fearful facial expressions, compared to angry faces, would divert attention to bad outcomes of disadvantageous decks (i.e., environmental threats) and increase the tendency to withdraw from risky options in the IGT. The results of the present study provided twofold contribution to related literature. First, when the risky deck is relatively easier to detect, fearful expressions, as compared to angry and neutral faces, enhanced the game performance. On the other hand, when it comes to a more difficult option, we found that both of the emotional facial expressions impaired the game performance. To conclude, the present experiment might be seen as a beginning step to explore the source of the threat explanation on decision making and reasoning processes.

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#### The Embodiment of Fear: Emotionally Congruent Body-State Facilitates Expressive Face Recognition.

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Embodied theories of cognition argue that the processing of emotions re-enacts congruent sensory and affective states. The recognition of emotional facial expressions has been shown to be influenced by the activation (or deactivation) of facial muscles used to express the same (or a different) emotion. This study explores if the processing other's facial expressions (faces expressing fear vs. neutral faces) can be influenced also by manipulating the participants' body-state, making it "emotionally congruent" with the expression to be processed (e.g., high heart rate in the case of faces expressing fear). A mouse-tracker study has been used to study gender categorization in young adults. Emotional congruency between participants' body-state and emotional valence of target stimuli was manipulated. We compared the performance of two groups of subjects (a "sport group" who performed physical exercise before the experiment and a "control group") in a task requiring to categorize pictures of male and female faces with fear or neutral expressions. Both groups performed a gender categorization task, providing their response by moving the computer mouse on the selected category. The effect of emotional congruency was valid only in the sport group, with faster gender categorization of faces with a fear expression. Results suggest that inducing an emotionally-congruent body-state influences the perception of other's facial expressions and this effect is automatically produced even when emotion recognition is not explicitly required by the task.

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#### Spatial Representations Affect Mental Rotation Performance and Its Strategies.

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Mental rotation (MR) is a widely used test to study spatial skills. There are reports on performance difference between men and women. Separate cognitive strategies are suggested to account for the variance in performance. While some people rotate 3-dimensional figures as a whole, using *holistic* strategy, others rotate in pieces, relying on *piecemeal* strategy. However, there is not a direct link between sex and strategies, as suggested, but other factors, specifically mental representation, can be responsible for the MR performance difference. To investigate the effect of different mental representations on MR task, we recruited only women undergraduates from Istanbul Sehir University (N= 56) in Istanbul, Turkey. To examine cognitive strategies, 3-D cube figures in both whole and cut versions were presented. In previous work, we found that participants rotated whole figures more efficiently than cut figures, mimicking the pattern of cognitive strategies. If any difference in MR performance would be because of the created mental representations, it should be observed with the whole and cut rotations. As hypothesized, preliminary analyses showed differences among participants who mainly used landmark and survey representations, especially at greater degrees of rotation. Interestingly we did not find faster rotation of whole figures as opposed to cut ones, like we did before. On the contrary, cut figures seem to be rotated faster over degrees of rotation. The interactions among factors provide further light on possible strategies and representations in processing spatial information.

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### The Development of the Stimulus for Research Insight Problem Solving in Eye-Tracking Methodology.

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Introduction. Cognitive psychology has an unsettled question about objectivation of solution processes of insight that have aim to discover mechanisms underlying it. For data analysis gathered by eye-tracker is important to uniform comparable stimulus. However, most experiments in this paradigm are built on solving problems that are arranged by different principles. Aim of this work is to develop such tasks that can be solved two ways through insight and algorithmic solution; these tasks must have a visual character to objectify solution process by using an eye-tracking methodology.

Methods. We propose to implement such type of problems in which «insightfulness» of solutions is an abstraction from the primary conditions for a given problem's representation and transition to another level of operating elements. In the first problem solver originally manipulates visual data type (He sees the arrow, fir-tree), while response involves access to the symbolic level (1, 3), because there are presented mirrored numbers. However, subsequent problems are arranged under the same scheme will not be insightful because the decision will not be a transition to a fundamentally new level of representation.

Results. The results suggest that this class of problems induces insightful decision at their first presenting, and may be considered as a type of algorithmic problems during their presenting after insight solutions. These problems can be applied to studies of insight problem solving by recording eye movements.

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### Breaking Down Unitization: Is the Whole Greater Than the Sum of Its Parts?

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Relational memory impairments are often observed in older adults, who have difficulty linking disparate elements. Using the transverse patterning task (TP), we have previously documented age-related impairments in the ability to learn novel relations. However, we have recently shown that *unitization* can mitigate such impairments both in amnesia and in healthy aging by fusing multiple items into a blended representation through an action. This unitization strategy is comprised of three component processes: (1) fusion, (2) motion, and (3) semantic comprehension of action/consequence sequences. Here we examine these component processes to determine which are necessary and sufficient to mitigate relational memory impairments. Healthy older adults completed TP with two sets of stimuli: first with standard training and then with one of four randomly assigned strategies (unitization, fusion, action/consequence, motion). The strategies used the same stimuli, but with different animations. For both standard and strategy conditions, participants underwent a training phase, followed by an immediate and 1-hour delay test. Participants showed equivalent impairments under standard training instructions across groups both immediately and following an hour delay. Importantly, only participants given unitization and action/consequence-only strategies showed improved performance following the 1-hour delay. Our results reveal that semantically-rich

action/consequence interactions are both necessary and sufficient to mitigate age-related relational memory impairments.

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### Effect of Physical Rotations and Gender for Navigation Performance in Virtual Environments.

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Physical motions may help orientation in virtual environments compared to only visual information. However, it remains unclear how much and what kind of motion is required to significantly increase orientation performance. In this study, we tested navigation performance in a virtual maze where participants (N=15) had to remember seven target objects and later point to them from different locations along the path. We compared two locomotion conditions: visual-only, where participants sat on a non-rotating chair and used the joystick for both forward movement and rotation; physical rotations, where participants sat on a swivel chair and controlled forward movement via joystick, while rotations were controlled by the Head Mounted Display's gaze direction. Spatial orientation performance was quantified as pointing error, absolute ego-orientation error, and configuration error. Females showed larger difficulties in maintaining self-orientation (ego-orientation error) than males,  $F(1, 60) = 5.110, p = .027, \eta^2 = .078$ , expanding prior research where gender differences are common in navigation studies. Unexpectedly, pointing consistency was better for the visual only condition,  $F(1, 60) = 5.160, p = .027, \eta^2 = .079$ . Post-experimental debriefing suggests this lack of a benefit from physical rotation might be related to the inconsistency of using body movements only for rotations, but not translations. This suggests that embodied interfaces should include at least some physical translation or translational motion cueing, like the NaviChair we are currently developing based on these findings.

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### Effects of Picture Repetition during Explicit and Implicit Categorization.

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The late positive potential (LPP) is a well-known component of the event-related potentials that reflects motivational significance. Previous studies have found that, despite a decrease in overall amplitude of the LPP with repeated presentation of the same picture, emotional stimuli continued to elicit a larger LPP than neutral pictures. These data seem to support the hypothesis that the categorization of emotional stimuli reflected in the LPP modulation is an obligatory process and does not rely on stimulus novelty. On the other hand, in these studies participants were only asked to look at the pictures (free viewing), making picture emotionality the most salient aspect of the stimulus, despite its repetition. Following this reasoning, we might expect a competing task will enhance the impact of picture repetition on the LPP affective modulation. In the present study, picture repetition occurred either in a free viewing context or during a categorization task (within subject design), with pictures depicting any mean of transportation as targets, and



repeated stimuli (both emotional and neutral) as non target stimuli. Replicating previous findings, emotional pictures continued to prompt a larger LPP compared to neutral pictures, after multiple repetitions, and even during the categorization task. These results suggest that the affective modulation of the LPP reflects an automatic engagement of cortico-limbic motivational systems, which continues to occur after multiple repetitions, regardless of the task-relevance of the stimuli.

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### **Integrating Spatial Memories Encoded Through Haptics and Language.**

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In two experiments we examined whether people integrate haptic and verbal spatial information they encode across different experiences into a single representation at the time of encoding or whether they maintain separate representations until the time of retrieval, when the task requires them to relate information across representations. While blindfolded, participants learned the locations of 6 objects placed on a table in front of them. They touched half of the objects and encoded the other half by listening to descriptions of the form "a shoe is placed at 1 o'clock". Participants studied the two layouts either from the same (Experiment 1) or from different perspectives (Experiment 2). Then, they carried out a series of pointing trials involving objects from either the same or different modalities (e.g., "Imagine facing the ball, point to the pot"). Results revealed equal pointing error and latency for same and different modality judgments when learning the layouts from the same perspective (Experiment 1). In contrast, when learning occurred from different perspectives (Experiment 2), participants were faster and more accurate for same compared to different modality judgments. These findings suggest that people readily integrate haptic and verbal spatial memories acquired at different temporal events to a single memory representation during encoding when learning occurs from the same perspective. However, when integration is more difficult due to encoding from different perspectives, people refrain from integrating during learning, keeping separate representations until the task requires them to do so.

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### **Temporal Categorization of Familiar Actions in Children and Adults.**

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Estimating the duration of an action or event often requires that we reference our own knowledge about the duration of similar action or event stored in long-term memory. As a consequence, the ability to encode and maintain action's durations in memory is a keystone of time estimation. We assume that people incidentally learned the duration of daily routine actions, so that their durations would be automatically remembered. The objective of our study is to investigate recall of memory for familiar durations in children and adults, by identifying for which actions the temporal experience has been sufficiently reactivated in memory to strengthen their memory trace, thus allowing individuals to recall these action durations. More precisely, we will examine whether or not children aged 3-,

5- and 8-years old and adults are able to categorize familiar actions according to their duration.

Participants were submitted to a forced-choice categorization task in which target action duration have to be paired with one of three comparison action durations either from the same duration, or from a longer duration, or even from a shorter duration than the target. The results showed that with age increasing, the percentage of accurate temporal categorization increased while that of temporal categorization errors decreased. These findings support our assumption that people are able to use the duration of familiar actions to organize their experience and representation, this ability clearly improving between the age of 3 and adulthood. These results will be discussed in terms of event cognition and time cognition.

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### **Capturing Mental Models of a Movie across Time.**

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Mental models are a class of models that focus on how we represent spatial relations among objects, predict how systems operate, or reason deductively. More recently, mental models have been used as an explanatory construct for comprehension of stories, including movies. However, capturing viewers' mental models of a story has been difficult using traditional measures of cognitive processes such as memory accuracy or response times. In this study we used multi-dimensional scaling (MDS) to realize viewers' understanding of the plot and characters in a movie. Four groups of college students watched the 1993 movie *Falling Down*, directed by Joel Schumacher and starring Michael Douglas and Robert Duvall. The main character is perceived at first as a company worker and family man who is fed up with everyday hassles and decides to confront them head on. As the movie unfolds, however, it becomes clear that he is mentally unstable. To investigate this change in understanding of the movie, four groups of college students (30 per group) watched movie, which was stopped after one-quarter, one-half, three-quarters, or the full length of the movie, depending on the group. When the movie was stopped, participants rated the similarities of the main characters and these data were submitted to MDS analyses. The analyses provided two-dimensional "canvasses" of how the characters were perceived and how participants' perceptions of the characters changed across time. The analyses and resulting canvasses afford a new way of capturing viewers' mental models of a movie as they are viewing it.

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### **Role of Metamemory and Cognitive Flexibility in Memory Strategy Adaptation: Generation Effect in Young and Older Adults.**

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Generation (rose-gar---) improves recall in young and older adults in comparison with reading (horse-riding) (generation effect, GE). When young adults take a similar test a second time, the GE is no more significant, because they increase their recall of read words: they are aware of the superiority of generation on performance, and

consequently, they adapt their learning strategies at Test 2.

We assumed that older adults would benefit from the generation at Test 2, because they are less aware from the GE at recall than the younger adults, changing of strategy is difficult (lower cognitive flexibility) and they use less of internal strategies.

Experiment 1: Younger and older adults learnt word-pairs by reading or generating. The test was repeated two times (with different lists) to assess the GE at Test 1 and Test 2. After the first test, participants were asked whether they noticed something particular in their recall. Cognitive flexibility and internal strategy use (MIA) were also assessed. The GE was significant for both groups at Test 1, but only in the older adults in Test 2. Older adults were less aware of the GE than the younger ones. The change of strategy from the first Test 1 to Test 2 was linked to cognitive flexibility and the use of internal strategies.

Experiment 2: Using the same protocol, instructions about the efficiency of strategies were provided to the participants after Test 1. For both groups the GE appeared at Test 1 only.

These experiments corroborated the idea that age-related impairment in adapting memory strategies is due to decline in cognitive flexibility and metamemory.

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### Who Maintains Cognitive Functioning in Old Age? The Big Five Personality Traits as Predictors of Cognitive Trajectories in the Health and Retirement Study, 1992-2012.

ELI TSUKAYAMA, JOHN J. MCARDLE, *University of Southern California*.

We examined the Big Five personality traits as predictors of cognitive trajectories in the Health and Retirement Study. The aging population poses major social, economic, and public health challenges. Identifying risk and protective factors for consequential life outcomes—such as cognitive decline—is crucial because such knowledge can inform public policy as well as efforts in prevention and intervention. Much of the extant research on this topic has been limited by examining relatively small non-representative samples and/or examining outcomes at one time point. In the current investigation, we use longitudinal latent curve analyses with a nationally-representative sample of older adults in the United States. The reported analyses are based on  $N = 11,691$  participants with 79,848 observations over 20 years. Conscientiousness and openness were positively associated with individual differences in cognitive ability, whereas extroversion was negatively associated with individual differences in cognitive ability. Similarly, conscientiousness and openness were positively associated with individual differences in changes in (i.e., slopes of) cognitive ability (i.e., highly conscientious and open participants had less steep declines), whereas extroversion was negatively associated with individual differences in changes in cognitive ability (i.e., extroverts had steeper declines); however, agreeableness was only negatively associated with changes in cognitive ability. Substantive implications are discussed.

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### Using Digital Tools Expands Perceived Near Space.

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We examined whether using digital tools, such as a computer mouse, affects perception of space. A growing body of research shows that extending our action capabilities through the use of physical tools can influence spatial judgments. For example, in a line-bisection task, people typically show a leftward bias for lines in reachable space relative to lines that are presented just out of reach, but when holding a stick, they show a constant leftward bias for both distances, suggesting that holding the stick expands perceived near space. We investigated whether this effect would extend to digital tools that allow for functionally-relevant action on digitally displayed stimuli. Sixty participants bisected near (30cm) and far (120cm) horizontal lines shown on a computer screen either by clicking on the line with the computer's mouse to enter their response, or by pointing at it with a laser pointer or stick, in which case the experimenter clicked on the location participants indicated. Replicating prior work we found a leftward bias for bisecting near lines relative to far lines. However, this effect only emerged when using a stick and a laser pointer; using a mouse resulted in a constant leftward bias. The results suggest that both physical and digital tool use can affect spatial perception, but only when the tool is functionally relevant within a given action space. Email: Elyssa Twedt, [etwedt@stlawu.edu](mailto:etwedt@stlawu.edu)

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### A Preferential Attention to Own Race Faces in Chinese: Evidence from a New Emotional Stroop Variant.

JING ZHANG, BEIYI CHEN, *Department of Psychology, Renmin University of China*. Researches on the preferential attention to race faces showed divergent results. Some studies found an in-group advantage. Other studies supported an out-group advantage. The perceptual learning model and the social cognitive model tried to explain the mixed results of preferential attention to racial faces. The current study attempted to examine the effects of attention levels and facial race to inform the debate of the two models. The present study manipulated two attention levels by two kinds of distractions: the emotion congruent condition and the emotion incongruent condition. In Experiment 1, the composed photographic stimuli were a happy or fearful face of a Chinese or a Caucasian overlaid with a positive or negative semitransparent emotion picture in the center of the face. Participants ( $N = 40$ , mean age =  $21.0 \pm 1.6$  years, age range: 19-24 years) were asked to categorize the central picture as showing an animated or inanimate body (/bodies). The results showed a faster response in the out-group condition than the in-group condition under the emotion congruent condition. No similar results were found in the emotion incongruent condition. Experiment 2 employed only Chinese faces in the background and yielded a confirmation with the results of the in-group condition in Experiment 1. These results supported the in-group advantage of attention to race faces and provided experimental evidences to the social cognitive model. The findings indicate that the racial face processing need attention resource and the processing should be on the conscious level.

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## Language Processes

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### What Are the Effects of Language Switching on Task-Switching Performance in Bilinguals?

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Studies examining effects of language switching on task switching have yielded mixed results, possibly related to bilingual-monolingual group differences. We therefore aimed to study the link between language and task switching within one group of bilinguals by manipulating the type of language task before or during colour/shape switching. Twenty young Italian-English and Spanish-English bilinguals completed two different paradigms with language and colour/shape trials. In the language part, they had to name pictures in their L1 and/or L2. In the colour/shape part, they had to name the colour or shape of an object in one language only. In paradigm A, participants switched between languages and colours/shapes in one mixed condition. In paradigm B, participants completed the colour/shape part three times. Each time, this task was preceded by a different language task (monolingual naming, bilingual blocked naming, or language switching). Preliminary results show no effect of language switching on task-switching performance in the mixed paradigm A. However, in paradigm B, switching costs in the colour/shape task were longer after a language switching task than after a monolingual naming task. This suggests that switching between two languages can hinder performance when task switching later needs to be completed in one language only. Furthermore, responses to task switches became slower as the number of preceding switches increased, possibly due to strategic predictions. This study offers a new way to investigate the impact of language use on task-switching performance in a within-subject design, thus avoiding the impact of language group differences.

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### Structural Characteristics of Individual Language Usage Is Stable Over One Year But Differs Over Topics.

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How we use language can reflect our personality. Personal language markers can be measured by the frequency of different function words independently of the actual content of speech. Previous studies on language markers focused only on English, which is a mostly isolating language with very little agglutination (morphological affixation). Here we show two studies investigating language markers and personality in an agglutinative language, namely Hungarian. In the first study, we recorded a three-minute-long spontaneous speech from young adult participants. We repeated the data collection one year later to test the stability of these language markers on individual level. In the second study we collected three different three-minute-long spontaneous speech samples from participants. They were asked to talk about three different movies they had seen previously and which they evaluate as sad, neutral or happy. After a voice-to-text transfer we used a natural language processing software to determine the incidence of

different language markers (e.g., number of occurrences of various suffix, content word and function word types). The results of the first study show that there are several markers which stay stable after one year. In the second study we succeeded to determine several marker types which can predict the three different - happy, neutral, and sad - topics. Our findings can help determine a linguistic fingerprint for individuals, not only in Hungarian but in other languages as well. This type of language analysis can provide markers for different emotional states, and it can be a useful tool in clinical diagnosis.

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### Text-Level Semantic Processing in Late Bilinguals.

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L1 versus L2 differences in semantic integration at the word or sentence level are relatively minor and can be explained as due to differences in proficiency. At the text level, successful semantic integration depends on high-level processes including creating and updating inferences. Here we explore inference, updating and semantic integration at the text level in highly proficient late bilinguals' L1 and L2. Twenty-four young adults were presented with short narrative texts in English (L1) and Spanish (L2). Participants were required to infer information from text (*inference*) and subsequently revise initial inferences (*updating*) in order to integrate a disambiguating text-final word. Longer reading times for new, inconsistent information reflect successful inference, while a reduction in N400 amplitude indicates greater ease of semantic integration and therefore efficient updating. We additionally assessed individual levels of L2 proficiency and proactive and reactive cognitive control. Participants were able to infer facilitated information in both languages, but less efficiently so in the L2. Successful updating, as indicated by N400 amplitudes, was observed in the L1 only. Efficient updating was associated with higher L2 proficiency and proactive control in the L2, but with reactive control in the L1. Even at high levels of proficiency, generating and revising inferences in a non-native language is less efficient compared to the L1, causing greater difficulties in semantic integration. Individual differences in cognitive control and L2 proficiency contributed to but did not fully account for these processing differences. L2 proficiency contributed to but did not fully account for these processing differences.

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### The Geometry of Handwritten Texts and Handwriting Automaticity.

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Background. Previous research has demonstrated that handwriting automaticity increases consistency and reduces spatial, temporal and pressure variability in handwritten texts (Meulenbroek & Van Gemmert, 2003). The present work explores the idea that the degree of automaticity of the handwriting process would also influence the spatial homogeneity of the written texts.

Method. In order to test this hypothesis, 64 adults and 49 children were asked to write a true and a fictitious version of their past

holidays. Several studies have supported the notion that creating a false story is more cognitive demanding than recollecting the true story (e.g., Sporer & Schwandt, 2006). On the other hand, handwriting automaticity increases through practice; thus, we assumed that it would be higher in adults than in children. We predicted that differences in handwriting automaticity would be reflected in the homogeneity of texts. We assessed spatial homogeneity through lacunarity, a non-linear measure that describes the distribution of points and gaps in a geometrical space. Results. Data analysis revealed a significantly lower lacunarity for true texts when compared with fictitious ones in the group of adults. However, no significant differences were observed between handwriting tasks in the group of children.

Conclusions. As expected, values of lacunarity in handwritten texts were sensitive to the cognitive demands of the handwriting task, and to the skill of the writer. Although more studies are needed, the proposed measure could be an index of handwriting automaticity, with a translational value in educational and clinical settings.

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### Epistemic Validation of Inaccurate Information Embedded in a Story: Evidence from Online and Offline Measures.

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Extant research indicates that on the one hand, readers are able to routinely and efficiently recognize and reject information that is in violation of what they know about the world (epistemic validation); yet on the other hand, they are frequently shown to be susceptible to inaccurate information embedded in stories (misinformation effect). One reason for these seemingly contradictory findings may be differences in the materials used: While studies on the misinformation effect often used trivia-like information of varying difficulty, studies on epistemic validation have used information that is blatantly inaccurate or implausible with respect to commonly held knowledge about the world.

The present study ( $N = 34$ ) was aimed at bridging these two lines of research by investigating the online processing of clearly inaccurate information embedded in a story by means of eyetracking while also testing for potential misinformation effects in a subsequent verification task. The results show that when inaccurate information embedded in a story contradicts commonly held and generally easily accessible knowledge, readers are rather successful at detecting this information and show little evidence of a misinformation effect. Moreover, relationships between online and offline measures provide insights into the mechanisms underlying the successful rejection of inaccurate information.

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### Ageing Does Not Make Us Dyslexic! How Age and Bilingualism Influence Reading Aloud Single Words and Pseudowords.

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The impact of both ageing and bilingualism on reading aloud

words and pseudowords is poorly understood. Harley et al. (2013) have claimed that “ageing makes us dyslexic”, based on their observation that older participants showed reduced pseudoword reading and repetition abilities, which are known markers of ‘phonological dyslexia’ in children and brain damaged adults. Furthermore, they suggested that this phonological processing impairment may arise as a consequence of age-related decline in executive functions. Although well documented in monolingual speakers, recent evidence suggests bilinguals are less vulnerable to this age-related decline of executive functions (e.g., Bialystok, et al., 2004). The aims of the present study were to (1) replicate Harley’s findings and (2) examine whether bilingualism would alleviate any age-related reduction in pseudoword processing. Neurologically healthy participants took part in a single word and pseudoword reading task. Participants were divided into groups as a function of age (older: 38-76 years vs. younger: 18-30 years) and language status (monolingual English speakers vs. Welsh-English proficient bilinguals). Our findings revealed a clear lexicality effect, with increased error rates for pseudowords relative to words. In contrast to Harley et al., our results do NOT indicate that pseudoword reading is less accurate in older participants. With respect to the effect of bilingualism, older bilingual participants outperformed the other three groups (i.e., fewer errors on both words and pseudowords). Taken together, these findings challenge the view that ageing induces mild phonological dyslexia but do suggest that bilingualism may lead to an advantage in phonological and/or executive functions.

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### Non-Selective Lexical Access in Bilinguals: Cognate Facilitation Extends to Sentence Processing.

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A large body of research suggests that bilinguals have an integrated lexicon (*BIA+* model of lexical access). Evidence comes from the observation of faster processing times of cognates than non-cognates. This facilitative effect has been observed in isolation, as well as within sentence contexts. The present study examines the effect of cognates on processing of sentences as whole units of meaning. Monolingual sentence processing literature (the *Structure Building Framework*) suggests that readers initially lay a foundation, the first mentioned noun, allowing subsequent information to map on to it, if that information is congruent. If information is incongruent, a sub-structure is created before information is integrated as a whole. Across two experiments, English-Spanish bilinguals read sentences with cognates embedded as either the first noun, or second noun of the sentence, while an eye-tracker monitored their eye movements. In experiment 1 ( $N = 66$ ), while reading in L1, first nouns took longer to process than second nouns. In addition, cognates embedded as the first noun facilitated processing throughout the entire sentence (observed in several eye-tracking measures). Results were replicated in experiment 2 ( $N = 54$ ) while reading in L2. Furthermore, facilitation was also observed when cognates were positioned as the temporary sub-structure (i.e. second noun). These data are the first to demonstrate that facilitative properties of cognates extend to larger units of meaning (i.e. sentence processing). In addition, they provide evidence that bilinguals process sentences similarly to monolinguals, extending the structure building framework to a



bilingual population.

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### **An Analysis of Topics and Vocabulary in Oral Narratives by Normal Speakers and Speakers with Fluent Aphasia – Implications for Rehabilitation of Lexical Retrieval.**

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Word-finding difficulty is a disorder experienced by all people with aphasia (PWA). The selection of appropriate training materials for rehabilitation should be based on a sound understanding of the manifestation of the deficit. However, Renvall et al. (2013) pointed out that the vocabulary of PWA is rarely studied. Davidson (2004) is one exception. Nonetheless, despite a sizeable amount of data, Davidson only examined output from 15 PWAs with a wide range of severity and their age-matched controls. It is not clear whether the observations would be relevant to rehabilitating PWA of particular aphasia types. The current study analyzed discourse production of 65 Chinese-speaking PWA of fluent types and their age- and education-matched healthy speakers ( $N = 130$ ) in terms of topics and vocabulary used in narrating the most important event in their life. The results show that there was significant overlap in topics between the two groups, fluent PWA were not restricted to topics of the “here and now”, while the vocabulary was larger for controls (1530 words) than PWA (1050 words) as expected, their distributions across parts-of-speech were highly similar, their vocabularies were of comparable frequencies of occurrence, and they included concrete and abstract items in all open word classes. More interestingly, while more different nouns than verbs were produced at the group level, proportionately more different verbs than nouns were employed at the individual level for both speaker groups. These findings are believed to provide new perspectives to clinicians rehabilitating the most persistent language problem.

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### **Age Differences in Eye Movements during Reading: A Meta-analysis.**

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The aim of this study was to compare the reading pattern, measured with the eye-movements, between two age groups: younger adults (mean age 21.1) vs older adults (mean age 72.8). To do this, we conducted a meta-analysis. Twenty-two experiments were found, from which we finally got the most informative six eye-movements measures (mean fixation duration, gaze duration, total sentence reading time, mean number of fixations, mean number of regressions and progressive saccadic length). A meta-analysis comparing both age groups in those measures was conducted, using Cohen's  $d$  (and Hedges'  $g$  correction) as the effect size indicator. The main results showed positive and significant effect sizes favoring the younger adults group (ES ranging between 0.53 and 3.68;  $p < .0001$ ) in five from the six measures, except for mean number of fixations, where differences didn't appear as significant. This results show that younger adults systematically make less fixations, regressions and saccadic movements during reading than older adults, what suggests younger adults follow different reading strategies from the

ones older adults follow, as other authors have previously suggested (Rayner et al., 2013). Eye movements may therefore prove to be useful and reliable indicators to measure changes that are produced in the way people read along the years.

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### **Understanding of Cataphors and Anaphors in Children.**

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**Purpose.** A common form of co-reference is anaphoric pronoun, which refers back to an entity previously mentioned in the text. Another form of co-reference, which has been less considered in the literature, is the cataphor in which the referent appears after the pronoun. This study evaluated both forms of co-reference in children aged from 8-to-10 years in a reading comprehension task.

**Method.** Two hundred twenty nine children (3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> graders) took part in the experiment.

A series of 32 direct object pronouns LE/LA (It/he/she) were tested in short texts. Half of texts contained a cataphor and half an anaphor. The processing of both forms varied according to the co-referential relation between the referent and the pronoun: object-object or subject-object grammatical relation. Children had to identify the referent of the pronoun highlighted in the text and to write down the appropriate referent.

**Results.** With age, children become more and more efficient in the processing of both forms of co-reference. Results showed a crossover interaction between pronoun form and co-referential relation: while anaphoric pronouns were easier to process when the grammatical function of the pronoun was concordant with that of the referent, an opposite result was observed for cataphoric pronouns.

**Conclusion.** The processing of both forms of pronouns is constrained by text structure but in a different way: for anaphors, parallelism of functions is the most important factor whereas the processing of cataphors gives priority to the distance between the referent and the cohesive marker.

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### **Distinct ERP Profiles for Learning Rules over Vowels and Consonants.**

JÚLIA MONTE-ORDOÑO, JUAN M. TORO, *Universitat Pompeu Fabra*.

The Consonant vowel hypothesis suggests that consonants and vowels tend to carry different information during language processing. Consonants tend to provide more information for lexical access, while vowels carry prosodic information. In this study we explored whether these functional differences triggered different neural responses in an abstract rule learning task. We recorded Event Related Potentials (ERP) while standard and deviant nonsense words were presented in an oddball paradigm. In the vowel condition, the stimuli were nonsense words with an ABB rule carried by vowels in the standard stimuli (paleke). In contrast, deviant stimuli implemented an ABA rule over the vowels (paleka). In the Consonant condition standard stimuli were composed by consonants following an ABB rule (palelo), while deviant stimuli



were composed by consonants following an ABA rule (palepo). The results showed that there was a different ERP distribution for the rules carried by vowels and by consonants. When the rules were implemented over the vowels, two positive components were triggered; one frontally distributed component between 250 and 350 ms and one centro-parietally distributed component ranging between 550 and 650 ms. In the case of rules carried by consonants, we also observed one positive component from 250 to 350 ms in frontal electrodes. However, we did not observe the later component. This difference suggests that the dissociable role observed for consonants and vowels correlates with distinct electrophysiological responses triggered when rule violations are detected. Email: [Júlia Monte-Ordoño, julia.monte@upf.edu](mailto:Júlia Monte-Ordoño, julia.monte@upf.edu)

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### A Process Interpretation of the Bilingual Advantage in the Flanker Task Using the Ratcliff Diffusion Model.

GABRIEL ONG, DAVID SEWELL, MEREDITH MCKAGUE, BRENDAN WEEKES, *University of Melbourne*, JUBIN ABUTALEBI, *Vita-Salute San Raffaele University*. Bilinguals have been shown to exhibit a response time (RT) advantage on the flanker task, relative to monolinguals. To date however, there is a lack of consensus regarding the mechanisms underlying this advantage. The current study analysed flanker task RT distributions in elderly bilinguals (N=29, age range =55-75) and monolinguals (N = 27, age range = 53-75) using Ratcliff's diffusion model. The diffusion model conceptualises decision making as a stochastic evidence accumulation process, and is governed by parameters with empirically validated psychological interpretations. These parameters were analysed to identify differences in processing that might arise between different language groups and flanker conditions. It was found that the bilingual advantage in RT manifests as an effect of non-decision time, which controls the onset of decision-making. Both monolinguals and bilinguals experienced increased non-decision time for incongruent flanker trials, however, the increase was relatively smaller for bilinguals. Previous research on the flanker task has linked the non-decision time cost for incongruent trials with an additional attention orienting process required when the target is surrounded by conflicting distractors. The findings therefore indicate that the cognitive advantage demonstrated by bilinguals on the flanker task may be driven by enhanced attention orienting in the presence of distracting peripheral information.

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### Proper Name Semantic Interference in the Elderly.

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Name retrieval difficulties during aging have been traditionally explained by a phonological transmission deficit or by an inhibitory deficit. The aim of this study is to explore the interaction between these two approaches during both object- and face-name production tasks using the semantic blocking paradigm. Three groups of participants (older adults with low educational level; older adults with high educational level; young adults with high educational level) were asked to repeatedly name objects or famous people in semantically homogeneous and heterogeneous contexts.

The results showed significant slower naming latencies for both face and object naming in the homogeneous context, with a stronger effect for face naming. Moreover, only older adults with low educational level showed an increased semantic interference effect during face naming. These results indicate that older adults with low educational level are more susceptible to interference, probably because of difficulties in suppressing competing proper names information. These findings would support the proposal of a deficit in inhibitory processes during aging, affecting particularly proper name retrieval in high interference contexts.

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### Investigating Community Norms and Linguistic Mechanisms in Codeswitching.

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Background: Previous investigation into how bilinguals process codeswitched language is based largely on experiments of individuals who do not code-switch (Kootstra, van Hell, & Dijkstra, 2012), though there are few exceptions (Guzzardo Tamargo, 2012; Valdés Kroff, Dussias, Gerfen, Perrotti, & Bajo, to appear). Given the close link between language usage and language processing (Bybee, 2010; MacDonald, 2013), there is a need to examine the processing of codeswitches in speakers who engage in codeswitching. This is the goal of the work presented here.

Methods: Bilingual verb phrases will be analyzed from a bilingual corpus (Travis & Torres Cacoullos, 2013) to extract the types of other-language items incorporated in spontaneous speech. These materials will then be used to create an experiment in which Spanish-English habitual codeswitchers will listen to a sentence, will complete a memory load task, and will repeat the sentence. The memory load component will add cognitive load so the changes participants make to the repetitions will be more aligned to their natural linguistic tendencies. Finally, non- codeswitching bilinguals living in Granada, Spain will complete the repetition task.

Predicted findings: We will examine which bilingual processing strategies are community norms unique to habitual codeswitchers and which are linguistic mechanisms interpretable by all bilinguals. We predict that habitual codeswitchers will be sensitive to the types of other-language items used in bilingual phrases and will be more accepting of verb switches than the bilinguals in Granada. By taking sociolinguistic and psycholinguistic approaches, we can study the link between production and comprehension in codeswitching.

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### Do We Say what's Easiest to Say, or what's Easiest to Understand?

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A recent debate in psycholinguistics is about whether language form and usage is shaped by the speaker or by the listener. According to the PDC model by MacDonald (2013), syntactic choices originate from speaker-strategies for optimizing production fluency. These choices shape the distribution of sentence forms in the language and subsequently influence expectations from comprehenders, facilitating—in turn—comprehension of frequent sentence forms. However, there is no robust experimental evidence yet, in support of this proposal.

In the present study, we investigated production choices (by 66 participants) using sentence fragments eliciting passive relatives (PR) or object relatives (OR) in Dutch (e.g., Q: *There are two toddlers. Boys entertain the toddler and the girls entertain the other toddler. Which toddler would you rather be?* A: *The toddler who is entertained by the boys* vs. *The toddler who the boys entertain*). Fragments promoted PR-choice either through comprehension (avoidance of ambiguity) or production biases (usage of verb-final biases). The resulting sentences were presented to 83 listeners in a comprehension task. Production choices and latencies were used to predict RTs in the comprehension task, using LME models.

Results indicate that PR comprehension times were significantly influenced by the likelihood of the speaker choosing this structure, specifically in items where a PR was not the easiest choice for the producer. These findings suggest that speakers do not always say what is easiest for them to produce, but that they sometimes consider more complex grammatical forms to be better understood. Email: Maartje van de Velde, [m.van.de.velde@fsw.leidenuniv.nl](mailto:m.van.de.velde@fsw.leidenuniv.nl)

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### Inducing Pure Alexia in Healthy Adults.

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Pure alexia (PA) is an acquired language disorder characterised by effects of word length on reading times and by an overt/covert letter-by-letter reading strategy. One account suggests the deficit is underpinned by an inability to process high spatial frequencies (SF) that are optimal for processing complex and highly confusable visual stimuli such as written words, pictures of living items and faces (Roberts et al., 2013, 2015).

Consistent with this account PA patients often show impairments in identification of these stimuli and in medium-high SF processing. The aim of this study is to test if the visual impairment in PA can be induced in healthy adults by filtering out the band of SFs hypothesised to underpin the deficit. Our results show that SF filtering produced (1) a word length in reading aloud and (2) a living<nonliving naming category effect. Thus, we were able to induce the length and category effects observed in PA. This strengthens the hypothesis of a causal relation between early visual processing deficit and in PA.

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### Encoding, But Not Retrieval, of Language Influenced by Attentional Resources.

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Syntactic priming, the phenomenon in which participants adopt the linguistic behaviour of their partner, is widely used in psycholinguistics to investigate syntactic operations. Current models of syntactic priming are mainly distinguished by whether they assume that it is an automatic, resource-free process or not. In this study we focus on attentional resources to determine if, as the amount of resources available decreases, syntactic priming magnitude also decreases. Participants completed a motion-object tracking task during either the encoding phase (N = 35) or retrieval phase (N = 32, data collection ongoing) of an active-passive syntactic priming task. Within a session, participants would randomly track 0, 1 or 3 balls. For the retrieval phase (tracking balls while describing pictures), we see no significant influence of resources available on priming magnitude. For the encoding phase (tracking balls while listening to picture descriptions), we do see an effect: an inverted U-shaped curve. When tracking 0 or 3 balls, participants show no priming magnitude, whereas they show the same priming magnitude when tracking 1 ball as they do in the retrieval phase. These results indicate that syntactic priming is an automatic behaviour; when there are too little or too many additional processes (such as attention), this automatic behaviour gets overridden. Additionally, these findings indicate that attentional resources influence syntactic operations when participants are processing incoming syntactic information, not when they are retrieving previously stored information. This study is the first to investigate the use of resources to elucidate underlying models of syntactic processing.

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### Mental Simulation during Text Comprehension: The Impact of Narrative Perspective and Gender Differences.

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Introduction: Previous research has suggested that readers mentally simulate the actions described in a text and represent the emotions of characters. Moreover mental simulation has been found to vary as a function of narrative perspective which can be manipulated through the use of pronouns. Using 'You' promotes first-person mental simulation and the internalisation of emotional states compared to 'He' (Ditman et al., 2010). The present study examined the impact of the manipulation of pronouns on the memory of actions and feelings of the main character of a story. A factor that was also explored was gender as this factor has been linked to differences in reading comprehension and episodic memory (Clinton et al., 2012). Material and Methods: The experimental passage included 30 verbs: 10 feeling verbs, 10 action verbs and 10 other verbs whose subject was not the protagonist. Two versions ('You' and 'He') were created. 80 participants (half men, half women) were allocated to one pronoun condition. They were instructed to read

the text carefully. After a 3 min-delay, they had to recall as many verbs as possible.

Results: An interaction was found between pronouns, type of verbs and gender. For women, using 'You' lead to an increase in the recall of feeling verbs compared to 'He'. For men, using the pronoun 'you' lead to an increase in the recall of action verbs compared to 'He'.

Conclusion: These results emphasize the importance of including gender into studies of mental simulation processes.

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### Feedforward and Feedback Phonological-Orthographic Consistency: An Event-Related Potentials Study.

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The recurrent theory suggests that bidirectional activation of orthography and phonology occurs during reading (Stone et al., 1997). Yet whether words with low feedback consistency (i.e. multiple ways of spelling a particular pronunciation) leads to greater competition and delayed lexical retrieval remains inconclusive. Given that Chinese is a deep orthography with irregular and arbitrary print-to-sound mappings and sound-to-print mappings, investigating such effects in Chinese may help resolve whether feedback consistency impacts on reading. An event-related potential (ERP) study using a homophone judgment task was employed with native Chinese speakers. Target characters varied factorially by token feed-forward consistency (FF-consistent vs. FF-inconsistent) and feedback consistency (FB-consistent vs. FB-inconsistent). Results showed enhanced N170 and P200 for feed-forward consistent characters, indicating that greater phonological similarity shared amongst orthographic neighbours elicited greater facilitative activation. In contrast, the feedback inconsistent characters elicited enhanced N170 and P200, suggesting that when more orthographic alternatives map onto a given pronunciation, greater neural resources may be required to activate multiple corresponding orthographic representations. Feedback consistency effects were also found at the N400 component with greater evoked negativity for feedback consistent characters. As feedback consistent characters have fewer orthographic competitors, these competitors may share a stronger weighted connection and require greater lateral inhibition amongst the candidate competitors consequently leading to more effortful N400 activation during lexical-semantic retrieval. Overall, these findings indicate that bidirectional activation of orthography-to-phonology and phonology-to-orthography occurs during word recognition, and motivates modifications to Chinese word recognition models that only propose unidirectional mappings from orthography-to-phonology.

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### Phonological Regularity Effects in Homophone Judgment in Second Language Chinese Readers.

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In Chinese character reading, phonological regularity is the congruence between pronunciations of the whole character and the phonetic radical as a standalone character. For first language (L1) readers, regularity effects begin to appear among good readers in

first grade. The current study sought to establish whether second language (L2) Chinese readers with alphabetic L1 and grade two Chinese reading level similarly engage in sub-lexical phonological analysis in reading. Eighteen L2 Chinese readers judged whether a visually-presented Chinese character was homophonic with an auditory syllable prime. In the regular-incongruent condition, the prime had no relation with character pronunciation; while in the irregular-incongruent (interference) condition, the prime corresponded to the pronunciation of the phonetic radical. L2 readers were less accurate in judging irregular characters, similar to L1 developing readers. An interaction between prime congruence and regularity was observed in RT. More time was needed to reject irregular-incongruent characters relative to regular-incongruent characters. Interestingly, a significant reverse regularity effect was seen where regular-congruent characters produced longer RT than irregular-congruent characters. One interpretation is that the interference condition created a context-induced bias prolonging decisions for all characters with a primed phonetic radical. This bias might be amplified because L2 readers had less automaticity in accessing character pronunciations, so they relied on the information provided by the phonetic radical. The findings suggested that the auditory prime pre-activated the phonetic radical which competed with whole character pronunciation and thus demonstrated that L2 Chinese reading involved phonological access to sub-lexical orthographic units.

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## Learning and Memory

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### Modulating variables in the Selective Directed Forgetting paradigm.

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It is widely known that people can forget previously learned information when cued to do so, and the directed forgetting (DF) effect has been broadly replicated. However, the idea that motivated forgetting can be selective has only recently been explored. By using an adapted procedure of the list-method DF paradigm, the Selective Directed Forgetting (SDF) procedure, Delaney and colleagues (2009) demonstrated that motivated forgetting can also be selective. Our aim in this study was to identify conditions that modulate the SDF effect. We explored the effect of variables such as whether or not participants believed the forget instructions and their willingness to forget, both reported by participants after performing the task. The effect of the emphasis while giving the instructions (instructions given either by the experimenter or just read on the PC screen by participants) was also studied. Finally, we analyzed the influence of circadian rhythms (Morning-preference and Evening-preference) and testing time (morning or evening) on the forgetting effect. Within a mixed empirical landscape of both reliable and non-significant SDF effects (e.g., Aguirre et al., 2014; Gómez-Ariza et al., 2013; Kliegl, Pastötter, and Bäuml, 2013; Sahakyan, 2004; Storm, Koppel, and Wilson, 2013), the results of this study highlight the importance of controlling variables that might affect cognitive functioning in general and the forgetting processes triggered in the SDF task, thereby constraining the emergence of SDF effects.

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### Individual Differences in Proactive Interference and Irrelevant Speech Effects in Working Memory Capacity.

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Previous literature has identified that individuals with high working memory capacity consistently outperform their low-span counterparts on a variety of short-term memory tasks. Whether this effect is due to greater attentional control, a larger cognitive capacity, or an increased ability to bind relevant recall information is debated. The current research aimed to explore individual differences in working memory capacity with regards to resistance to distraction, one of the key functions of working memory. The participants were administered an updating task in which proactive interference was manipulated. Effectively, participants were asked to inhibit or suppress old information that was once relevant but no longer was. This task was conducted in the context of background speech which the participants were told to ignore. Thus, the experiment examined individual differences in resistance to PI and to irrelevant speech. When working memory capacity was not considered, both proactive interference and irrelevant speech priming effects were readily apparent in the data. However, when working memory capacity was used as a covariate, proactive interference effects were eliminated, but irrelevant speech effects were not. The proactive interference findings can be best explained under the binding hypothesis which suggests that high-span individuals can more efficiently bind items for survival against distraction in later recall than low-span individuals. The irrelevant speech outcomes are best explained in terms of semantic and phonemic item interactions within semantic memory.

Main topics: Attention and Performance – Cognitive control; Learning and Memory – Recall, Working Memory  
Keywords: working memory capacity, individual differences, proactive interference, irrelevant speech effects, binding hypothesis  
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### The Feedback of Good Rankings in an Exam diminishes the Testing Effect.

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Testing is very often without competition with peers but it is not clear how the testing effect, i.e., the better memory for repeatedly tested items than studied ones, is affected by the pressure from peer competition. We examined this issue by providing positive (high-ranking among peers), negative (low-ranking), or neutral feedbacks to participants when their memories for 60 Swahili-Chinese word pairs were repeated tested. All participants were in similar levels of anxiety initially but the negative group became more anxious after knowing that their performance was poor in comparison to their peers. In the immediate test for all the repeated studied and tested word pairs, the positive group gave rise to the worst cued-recall performance but the magnitude of the testing effect was statistically equivalent for all the three groups. In the one-week delayed test, the testing effect was of the same magnitudes for the positive and the neutral groups as in the immediate test but was diminished for the negative group. These results suggest that the testing effect might

be resistant to the effect of social pressure.

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### Influence of Emotion on Event Memory: Introducing the First-Person Perspective Film Paradigm.

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Our memories for events play a vital role in how we interact with and form representations of the world. As these types of memories are reconstructed every time they are retrieved, they can be influenced by a variety of factors, including how emotionally arousing the event was and whether it possessed an emotional valence. Problematically, the majority of research in this area, especially with regard to personal event memories, has been unable to examine what happens when people initially experience events, as these events typically occur in people's private lives outside the laboratory. Studies have instead focused on asking participants to recall their memories, with no control over what information was encountered. The present study investigated the influence of emotional variables using a new experimental paradigm: the First-Person Perspective Film paradigm. As part of this paradigm, participants viewed first-person perspective film clips while keeping an overarching goal in mind to ensure immersion in the film clip and the experiencing of emotion. Across three experiments, we investigated how emotional valence, emotional arousal, and stimulus saliency influenced participants' recall and accuracy regarding these clips. The results revealed that stimulus saliency mitigated previously documented effects of valence and arousal on event memories. In addition, the results demonstrated these variables influenced event memories retroactively, providing evidence the influence of emotion occurs through memory-based mechanisms rather than attentional mechanisms.

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### Independent Capacities but Constrained Output Orders in the Simultaneous Free Recall of Auditory-Verbal and Visuo-Spatial Stimuli.

CATHLEEN CORTIS, GEOFF WARD, KEVIN DENT, *University of Essex*.

We examined capacity limits and output orders in immediate free recall of spoken words and visuo-spatial stimuli when these were presented either in single- or dual-modality lists. In Experiment 1, three groups of 20 participants were presented with lists of between 1 and 16 spoken words (words only), between 1 and 16 visuo-spatial dots (dots only), or between 1 and 16 words and dots presented with synchronised onsets (synchronised words and dots) for IFR. Participants recalled the words out loud and/or clicked on the dot locations using the computer mouse. Replicating recent earlier work (Cortis, Dent, Kennett, Ward, 2015), we found qualitatively similar patterns of serial position curves and output orders with increasing list lengths in both the word only and the dot only conditions. There was very little, if any, reduction in the number of items recalled in the synchronised words and dots conditions, relative to the single-modality conditions, but the output orders were strongly constrained - there was a marked tendency for successive responses to be from alternating stimulus domains, with

successive pairs of item from equivalent or nearby serial positions. These findings were replicated in Experiment 2, using lists of exclusively 6 words and/or dots for IFR. However, some trade-off in visuo-spatial (but not verbal) capacity occurred in a fourth group when the words and dots stimuli were presented in alternation. We describe how this innovative data set can both constrain and extend current theories of immediate memory.

Cortis, C., Dent, K., Kennett, S., & Ward, G. (2015) First things first: Similar list length and output order effects for verbal and non-verbal stimuli. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 41 (4), 1179 - 1214.

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### Characterizing the Relationship between Semantically Similar and Dissimilar Words in Recognition Memory.

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It is well established that semantic similarity plays a role in recognition memory, whereby targets and lures that are semantically similar to the studied words are more likely to be considered targets. There is less work addressing the role of semantic similarity on the response rate of semantically dissimilar words. To address this, we varied the proportion and type of semantically similar words being tested, which lead to a change in the amount of semantically similar words that were considered targets. Here we have shown that as the amount of semantically similar words considered targets increases, the amount of dissimilar words considered targets decreases. Further, we show that if participants are tested on the semantically similar and dissimilar words separately, the amount of semantically similar words that are considered targets decreases. These results suggest that the perceived contrast between semantically similar and dissimilar words is a critical aspect of the semantically similar word response bias. An initial characterization of this phenomena is depicted and possible explanations are discussed which attempt to lay the groundwork for future exploration into the role of semantic similarity in memory.

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### Effect of Time on Event Characteristics of Autobiographical Memories: A Comparison of Different Samples and Different Methods.

BERIVAN ECE, *MEF University*, SAMI GULGOZ, *Koç University*.

We explored whether there is a consistent pattern in the way memory characteristics change over time. Three studies with different samples and methods were compared. The first study had autobiographical memories from 64 (33 female) old adults ( $M_{age} = 60.59$ ,  $SD = 6.72$ ) by cue-word or important-events technique. The second study had data from 160 (83 female) young adults ( $M_{age} = 20.28$ ,  $SD = 2.81$ ), and the third one had data from 67 dancers (28 male,  $M_{age} = 27.16$ ,  $SD = 4.48$ ) regarding their memories of competitions and shows. For each reported event, participants rated importance, emotional valence and intensity. They provided both concurrent ratings of these characteristics during retrieval and retrospective ratings for the time of encoding. All these studies displayed the same consistent finding for importance and

emotional intensity of memories reported by different age groups by different methods. Autobiographical memories seem to loose their importance and emotional intensity over time. For emotional valence, results displayed variation. Memories collected by the important-events method become more positive over time for elderly whereas they displayed no difference for the young adults in the second study. Finally, for the dancers memories of competitions and show became more negative over time resulting from the improvement and better performances they had later on. In short, importance and emotional intensity were vulnerable to passage of time while valence was differentially affected.

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### Word-length Effect: A Comparison of the Norms of Spanish vs English Children and Adolescents on Digit Span Task of the Test of Memory and Learning.

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The fact that immediate serial recall is better for short words than for long words is called the word-length effect (Baddeley, Thomson, & Buchanan, 1975). It is one of the key phenomena in the development of short-term memory theories. This phenomena is relevant in the measurement of individual differences in short-term memory span when it is measured by digit span tasks. In these tasks, where participants are asked to recall serials of digits forward or/and backwards, the phonological properties of number words in different languages affect achievement. The present study was conducted to show the word-length effect in a digit span task comparing the norms of the 582 Spanish children and adolescents from 5-to-19 years old, and 1,342 English children and adolescents of the same age, in the Test of Memory and Learning (Reynolds & Bigler, 1994, 2000). We compared the percentiles of four tasks: Visual Selective Reminder, Visual Sequential Memory, Digits Forward-Backward, and Memory of Stories. No differences were found among English or Spanish sample on visual and verbal tasks, except for digit span, where Spanish yielded lower scores than English sample. We found similarities in the growth of short-term memory as measured by TOMAL and by WAIS (Sebastián & Hernández-Gil, 2012).

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### Working Memory Training for Improved Reading Comprehension.

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Children with dyslexia account for approximately 17% of American youth. Reading comprehension involves considerable working memory (WM), and WM deficits are among the major underlying factors driving reading difficulties in dyslexia. A promising approach is to improve WM for dyslexic students. Research has indicated that WM is malleable, and studies of WM training (WMT) have improved both WM and reading ability in non-dyslexic (ND) children. Our study is a pre/posttest randomized





controlled trial with 4th and 5th grade dyslexic and ND students, randomly assigned to the WMT or control condition. Children train on three WMT games or on control games for 10 sessions lasting 15 minutes each and take pre- and posttests of WM and reading ability. We are collecting data at two elementary schools in California. Data collection at the first school is complete, and preliminary results indicate near transfer to WM measures and far transfer to reading measures. Email: Masha Jones, [m.jones@uci.edu](mailto:m.jones@uci.edu).

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#### **Saving Some Information on External Media Helps Other Information within Our Internal Memory: A Case of Photographing.**

MASANORI KOBAYASHI, JUN KAWAGUCHI, *Nagoya University.*

People can record information easily by external memory media, such as digital cameras, but previous evidence showed that photographing objects lead to memory of the photographed object to be less accurate (Henkel, 2013). However, it is still unclear whether photographing influences other information in our memory except the photographed information. Accordingly, the present study investigated whether photographing some information enhances subsequent learning of other information, via two experiments. As Storm and Stone (2014) revealed that saving some information on a personal computer enhanced subsequent learning of other information, we hypothesized that the same effect might be assumed in photographing as well. In a photograph block, participants studied eight words in list 1 and then photographed these items. After learning list 1, participants studied other eight words in list 2 and took a free-recall test of list 2 items. Finally, participants re-learned list 1 items on smartphone and took the free-recall test of list 1 items. The control block was the same procedure as the photograph block except that photographing and re-learning were omitted. List 1 and 2 items came from different categories (low proactive interference) in Exp.1 and from the same category (high proactive interference) in Exp.2. Our results showed that memory performance of list 2 items in a photograph block were higher than that in a control block in both experiments, in support of our hypothesis. Thus, we demonstrated that photographing enhances subsequent learning.

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#### **The Effects of Note Taking Medium Based on Lecture Format.**

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Research on the use of technology in classrooms yields conflicting results in regards to learning impairment. Recent studies have shown that laptops, when used for note taking, can impair learning due to shallower processing than for longhand note taking, as computer note takers tend to use a nongenerative (verbatim) note taking strategy. Longhand note takers benefit from an additional level of processing by using a generative note taking strategy (summarizing and paraphrasing). Previous research is conflicting when looking at the overall effect of PowerPoint presentations on learning. Of the research that has been conducted, about half the studies show an increase in student performance, whereas the remaining half show a decrease in performance attributed to the PowerPoint presentations.

However, the effect on note taking of PowerPoint presentations used by instructors has yet to be determined. Students who view PowerPoint presentations might benefit from the summarization effect because attention is directed towards the most relevant information, thereby improving comprehension and retention. The present study examines the effect of note taking medium (longhand, computer, no note) and lecture type (PowerPoint, no PowerPoint) on learning and retention. Findings suggest that PowerPoint presentations could facilitate learning in the shallow processing conditions (computer, no note), perhaps through the benefit of summarizing the information. Longhand note takers more consistently performed well regardless of lecture type, maybe taking advantage of the generation effect. A verbatim-from-slide measure allows for an analysis of these effects. Overall, longhand note takers had less verbatim overlap than did computer note takers. Email: Lakshmi Lalchandani, [lakshmi.lalchandani@colorado.edu](mailto:lakshmi.lalchandani@colorado.edu)

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#### **On the Role of Proactive Interference in Visual Working Memory Tasks.**

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Visual working memory (VWM) is an online memory buffer that is typically assumed to be immune to source memory confusions. Accordingly, the few studies that have investigated the role of proactive interference (PI) in VWM tasks found only a modest PI effect at best. In contrast, a recent study has found a substantial PI effect in that performance in a VWM task was markedly improved when all memory items were unique compared to the more standard condition in which only a limited set of objects was used. The goal of the present study was to reconcile this discrepancy between the findings, and to scrutinize the extent to which PI is involved in VWM tasks. The first three experiments showed that the robust advantage in using unique memory items can also be found in a within-subject design and is largely independent of set-size, encoding duration, or inter-trial-interval. Importantly, PI was greatly diminished when the items were presented, either simultaneously or sequentially, at distinct locations rather than at the center of the display. These results indicate that PI is spatially specific and that spatial information assists in protecting VWM from source memory confusions. Thus, these findings imply that spatial information plays a special role in VWM and underscore the notion that VWM is more vulnerable to interference than is typically assumed. Email: Tal Makovski, [talmak@openu.ac.il](mailto:talmak@openu.ac.il)

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#### **Characteristics of Memories for War Experiences.**

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The study of traumatic memories has generated a heated debate in recent years due to the implications it has for understanding of the emotional memory mechanisms and the implications it has on some legal cases. Several studies showed that traumatic memories are different from other types of memories, while others affirmed traumatic memories are similar to any other type of autobiographical memory. Phenomenological characteristic gives the feeling that a particular mental representation is a memory of a real event that happened during his/her lifetime, instead of a mental representation

of an imagined event or any other kind of representation. The aim of this study was to evaluate the phenomenological characteristics of memories for war experiences in Gaza Strip during summer 2014. One hundred participants completed the Phenomenological Questionnaire for Autobiographical Memory one year after the war. Half of the participants valued their memories for war and the other half for positive valence experiences. Results showed the two types of memories differ in complexity, confusion, sensory and contextual information, and the number of times participants recovered that information over time. Data support the conclusion that traumatic memories of war differ qualitatively from those reports on positive events.

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### No Own-Age Bias for Young Adults When Perceived Age of the Face Is Used.

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The own-age bias is the better recognition for faces of people from the same age group. Most of the experiments in the topic have used the actual age of a series of pictures to classify them as same-age or other-age. However, several studies suggest that there is a drift in the perceived age, meaning that participants in a typical own-age study may think that a face from one group actually belongs to another. In addition, attractiveness and typicality (defined as how typical or common the face is for the participant) of the face have been shown to affect memory for faces. In this research the objective was to study the relationship between attractiveness and typicality in the own-age bias but using the perceived age of the face instead of the actual age. In the study phase participants ( $M = 20.21$  years old) had to indicate the perceived age, the attractiveness, and the typicality of faces. After a filler task, participants completed a yes/no recognition test with studied and new faces. Results showed a strong relationship between attractiveness, typicality, and perceived age, but no own-age bias. Discrimination, measured with hits minus false alarms, was higher for faces of children and old adults, for faces rated with low attractiveness, and low typicality. In general, the results showed that there is no own-age bias for young adults when the perceived age, and not the actual age, of faces is used.

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### Effects of Content and Frequency of Feedback on Complex Human Learning.

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In conditional discrimination studies, participants receive feedback for their responses on each trial, normally being the presentation of the word "correct" or "incorrect" the only information in regards to their choice. However, both the frequency and content of the information or feedback may vary. The purpose of the study was to evaluate the effect of content and frequency of feedback on learning and transfer. Two groups of participants were formed ( $N = 48$ , mean age 26.3); the groups were different in terms of the feedback's frequency – continuous vs. intermittent. Each one of

these two groups was differentiated by the type of information specified in the feedback – partial vs. total. The percentage of correct responses was higher for groups with continuous feedback in comparison with those with intermittent feedback. We also found that the total feedback groups showed higher percentages of correct responses than groups with partial feedback. In the transfer it was found that continuous groups showed a higher percentage of correct responses. Taken together, the findings reveal that there is an interaction between the frequency and content of feedback on the acquisition and transfer of complex learning.

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### The Generation Effect Revisited: Enhancements for Item and Context Memory.

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Self-generated information is often better remembered than non-self-generated information. This effect has been robust for item memory (i.e., the content of information) across different generation tasks, stimuli, and memory tests, but inconsistent for memory for contextual details (e.g., memory for the extraneous details associated with the content of information, such as source). However, previous studies examining the self-generation effect often apply constraints on the to-be generated information, likely resulting in an underestimation of the memory benefit from self-generation. In two experiments, we compare memory benefits of an unconstrained versus a typically used constrained self-generation task using measures of both item and context memory. Results showed that generated words in an unconstrained task were consistently better remembered than words in the constrained task for both types of details. Overall, these experiments suggest that the generation effect may be larger than previously articulated, suggesting that self-generation is a powerful mnemonic that leads to enriched memory representation for both the content and context of episodic events.

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### Do People use Category Learning Judgments to Regulate Their Learning of Natural Categories?

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Few studies have evaluated peoples' category learning judgments (CLJs), which are metacognitive judgments where people decide how well they will be able to categorize new members of learned categories. Our aim was to evaluate whether people use CLJs when making restudy decisions, and if decisions differ based on task demands. In the first two experiments we had participants study members of bird families, make CLJs for each family, and then decide which families they would like to restudy. We manipulated the number of bird families participants were allowed to restudy (either 3 or 9 of 12 families). We predicted that when participants could only choose 3, they would pick the easier ones (that they had given higher CLJs), and when they could choose 9, they would pick the more difficult ones (that they had given lower CLJs). In contrast to our predictions, however, participants either decided to restudy the more difficult-to-learn families or to restudy the easier-to-learn families, but not in accordance with our manipulation. Thus, in



a third study, we asked participants a series of questions about how they chose families for restudy. Consistent with the previous experiments, those who chose families they gave higher CLJs reported strategically choosing easier ones and those who chose families they gave lower CLJs reported strategically choosing more difficult ones. Thus, people do use CLJs to choose which concepts to restudy, but some unknown individual-difference factor moderates whether they choose the easier concepts or the more difficult ones. Email: Kayla Morehead [kmorehea@kent.edu](mailto:kmorehea@kent.edu)

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### Memory for Events: Recall of Real and Virtual Experiences.

ELAINE H. NIVEN *University of Dundee*, ROBERT H. LOGIE *University of Edinburgh*. Memory for personally experienced events is often characterized as subject to rapid loss of detail. However, remarkable persistence of memory has been demonstrated over time frames of many months (Wynn & Logie, 1998; Campbell et al., 2011) following an initial review. Current practice frequently relies on assessment of recall consistency and volume of reported detail across two different time points (initial and subsequent review); we investigated a means for comparing event memory with recorded versions of experienced events. Specifically, we aimed to assess whether a virtual version of an environment provided sufficient opportunity for episodic-rich experience and recall. 24 participants spent 15 minutes navigating around a detailed virtual reality replica of a real world museum exhibit, and 24 participants did the same in the real world exhibit. Subsequent recall of this event was recorded, and analysed using the Autobiographical Interview scoring technique and rating scales (Levine et al., 2002). Ratings from three trained coders found comparable performance between environments, suggesting that event-based memory appears to be equally episodically rich after exploring a virtual environment or after exploring the same real environment. Moreover, use of virtual environment exploration appears to be a potentially fruitful means by which to move beyond consistency-focused analyses in testing event-based memory, and to provide an opportunity to investigate effects of time frames as separate from those of post event review. Email: Elaine H. Niven [e.niven@dundee.ac.uk](mailto:e.niven@dundee.ac.uk)

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### It Is Not That Random: What You Remember Influence Subsequent Recall.

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Emotional deviation has been considered an essential factor in emotion regulation, in that, attempts to compensate for the deviation is reflected on cognitive processes. In the present study, we focused on autobiographical remembering and tested the functional role of memory on the emotion regulation. We specifically examined how recalling emotional events influence individuals' subsequent memory reports. Individuals ( $N = 153$ ) were randomly assigned to two groups to report either sad or neutral events that they experienced in the last five years. Sad and neutral memories were found to differ in the way they influenced subsequent recall. Although valence and intensity ratings were similar, compared to individuals who initially reported neutral memories, sad memory group attributed less importance to the events in the subsequent recall, but more notably, they perceived these events more psychologically distant. However, when we focused on the specific features of the emotional

memory, we found that the more visual imagery and reliving were reported for sad memories, the more negative the subsequent recall tended to be. Overall, we argue that it is not solely the valence of the memory that determines what we remember, as in the mood-congruency effect. We discuss more complex mechanisms in the light of explanations by a functional approach to autobiographical memory.

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### The Role of Practice Schedule in the Durability of RIF. Evidence from Electrophysiological Data.

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Retrieval-induced forgetting (RIF) is the product of a control mechanism in charge of making competing memories less accessible during target retrieval. In our work, we aimed to better understand the nature of this putative mechanism by investigating the role of a retrieval practice schedule in RIF. According to previous behavioral and neuroimaging evidence we predicted that spaced retrieval practice, relative to massed retrieval practice, would lead to enhanced forgetting. In Experiment 1 we manipulated the practice schedule (massed vs. spaced) and the delay between the last retrieval-practice trial and the final test (5-min vs. 24-h). Reliable forgetting was found on the immediate test after both massed and spaced practice schedules, however, an extended RIF effect lasting 24-h was found only after spaced retrieval. In a second experiment we replicated these data for the 24h interval and also explored the neural correlates of spaced schedule in RIF. We found differences in the N400 effect and in theta power for the spaced versus massed conditions. These findings suggest that spaced retrieval may modulate the durability of RIF via competitor reactivation.

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### Repetition Increases False Recognition in Elderly People (Either Healthy or Cognitive Impaired) but Not in Young Adults.

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False recognition seems to increase with aging and cognitive impairment. Four samples (young adults, healthy older people, elderly people with mild cognitive impairment, older people with Alzheimer disease) were compared in an associative recognition experiment in which half of the stimuli were repeated during the study task. Participants had to distinguish between intact, rearranged and new pairs in the recognition task. False recognition was estimated by subtracting false alarms committed in new pairs from false alarms committed in rearranged pairs, respectively, in order to control the response bias usually found in older people. Results showed that repetition increased false recognition in all elderly people samples (either healthy or cognitive impaired) but not in the young adults sample. What seems to occur in rearranged pairs is that young people (but not elderly people) are able to recollect the original associate of one of the items in order to reject the rearranged lures, using repetition to improve this *recall-*

to-reject monitoring strategy. However elderly people show a monitoring deficit and respond to rearranged pairs based mainly on the familiarity of each item (which is increased by repetition). Our results could be explained by the activation/monitoring theory.

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### Reactivation, Modification and Reconsolidation of Fear Memory.

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If fear memories become persistent and maladaptive, they generate many of the known anxiety disorders. As a result, research focusing on the process of memory reconsolidation has been developed. It seems that memories can be altered after being reactivated. In this area there is evidence of reconsolidation in non-human studies with pharmacological blockade techniques of reconsolidation. However, in human studies, this pharmacological manipulation could be problematic. Among the non-pharmacological research on human reconsolidation work include Schiller et al. (2010), published in *Nature*. In this study electric shocks were used as aversive stimuli in a procedure consisted of three phases in three different days. The present work focuses on the reactivation, modification and reconsolidation of fear memory. It means to generalize the above study by means of a similar procedure of conditioning. Thus, we used a mixed design (inter-intrasubject, 2x2) through a differential classical conditioning paradigm. The procedure consisted of three phases held in one single session and an loud *white noise* was used as an aversive stimuli. The results indicate that there was a significant reduction in the fear response in the experimental group, whereas this was not the case in the control group. In conclusion, our data supports the results achieved by Schiller et al. (2010) and suggest that it would be possible to modify fear memory through behavioral techniques, generalized and extended in our work to an auditory aversive stimuli.

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### Impact of Age and Sociocultural Background in Working Memory.

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Working Memory (WM) is a system that maintains and manipulates information for short periods of time, which is essential for academic and professional performance. In childhood studies, sociocultural background more than socioeconomic status seems to play a role in working memory functioning. Nevertheless, its effects are less studied in adulthood. To verify if WM could be influenced by the sociocultural background we contrasted native Portuguese speakers born in two different countries. The first study investigated the performance of undergraduate students from public universities in Brazil ( $M_{age} = 19.03$ ;  $SD_{age} = .72$ ;  $n = 30$ ) and Portugal ( $M_{age} = 18.83$ ;  $SD_{age} = .65$ ;  $n = 30$ ) in 6 tests of Automated Working Memory Assessment (AWMA). Results showed no differences between groups on the WM measures. Thus, similarly to what is

observed in childhood studies, this finding suggested that WM tasks seem to be impervious to differences in sociocultural backgrounds. Moreover, a second study was carried out to analyse the impact of age in visuospatial and verbal WM measures (AWMA) in a Brazilian sample of young adults ( $M_{age} = 18.89$ ;  $SD_{age} = .72$ ;  $n = 29$ ) and adults ( $M_{age} = 27.90$ ;  $SD_{age} = 6.32$ ;  $n = 29$ ), using the same instrument. Age-related differences were found in that young adults presented higher scores than adults in two tests (Mister X and Spatial Span) and in the visuospatial WM composite. Therefore, in the present study, visuospatial WM was more sensitive to age differences than verbal WM for undergraduate students.

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### Regulating Eyewitness Memory Accuracy Over Time With and Without the Plurality Option: The Mediating Role of Cognitive and Metacognitive Components.

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In real-life situations remembers generally have two types of control: (1) control of report option, and (2) control over the grain size. In this study, we examined the cognitive and metacognitive underpinnings of free-report memory accuracy over time, using the Quantity-Accuracy Profile (QAP) methodology developed by

Koriat and Goldsmith (1996). In Experiments 1 and 2, when the participants were given control of report option with no control over the grain size, the reliability of their accounts dropped substantially over the 48-hour retention interval, largely due to deteriorating metacognitive monitoring effectiveness (i.e., the ability to differentiate correct from incorrect answers). Apparently, due to a rapid decline in the accessibility of verbatim fine-grained traces (representing detailed episodic information) over time, the participants tended to rely mainly on gist-based processes, which brought to mind prototypical information that was often incorrect yet confidently held and freely reported, as a result of false memory persistence. In Experiment 3, the control of grain size was enabled as well, using an adaptation of the plurality option introduced by Luna, Higham, and Martin-Luengo (2011). Accordingly, in the free-report phase, the participants were allowed to volunteer either a single answer or a plural answer (i.e., two probable alternatives), or to refrain from answering altogether. The results show that although the participants utilized the plurality option systematically, tending to volunteer a plural answer only when the single answer was relatively unreliable, the decline over time in free-report accuracy was not eliminated due to false memory persistence in the volunteering decisions.

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### Response Stability in Artificial Grammar Learning Using Relearning Methods.

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In the context of implicit learning research using artificial grammar learning paradigm, participants' grammatical judgment for a novel stimulus and subjective confidence in their judgment about grammaticality at test phase followed grammar learning phase were used as the measurements of the participants' learning performance. In particular, in many studies, correct rates of grammatical judgment with low subjective confidence were defined





as the participants' implicitly learned results. However, it is also predicted that subjective confidences are influenced by participants' personal character and their cultural backgrounds. In this study, the artificial grammar learning tasks based on the standard artificial grammar paradigm composed of the learning and the test phases were repeated twice with a year interval period. Nine children took part in this experiment (age range 11-13). Concordance rate of responses at two different time points for identical stimuli was calculated each participant. As a result, with regard to judgment about grammaticality, concordance rates were significantly higher than chance levels. In contrast, with regard to subjective confidence for grammatical judgment, there was no significant difference between concordance rates in two time points and chance levels. The lack of stability of subjective confidence as an index of implicit learning was discussed.

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### **Learning Differences In Self-Paced Versus Fix-Paced Form of Implicit Sequence Learning.**

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Implicit sequence learning has been defined as sensitivity to regularities, patterns and statistical dependencies in the environment. One of the most important challenges is to understand how sequence learning occurs and how the acquired information consolidates in the brain. Evidence shows that explicit learning performance is better on self-paced tasks compared to fix-paced tasks. The effect of task pacing on implicit learning, however, has not yet been comprehensively characterized. Our aim was to fill this gap by exploring how task pacing affects implicit sequence learning. Learning was measured by the Alternating Serial Reaction Time (ASRT) task. In the fix-paced condition, the stimulus was presented for 580 ms, then a 120-ms delay was administered before the next stimulus. In the self-paced condition, the stimulus was on the screen until the participant pressed the correct button, then a 120-ms delay was administered before the next stimulus. The fix paced group showed faster performance but smaller sequence-specific learning compared to the self-paced group. These results suggest that the fix paced condition was more attention demanding that interfered with the resources required for implicit sequence learning. These findings support the theory that some level of attention is required for implicit learning.

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### **Monitoring Own and Others' Recognition Performance: Effects of Child Development and Task Experience.**

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Background. Children are typically overconfident when evaluating performance. Overconfidence might be more apparent when children give credit their own performance than when they give credit to others. This because children often do not distinguish between their wishes and their expectations when evaluating their own performance. Further, children tend to have difficulties

taking previous task experiences into account when evaluating performance. We addressed how development affects children's ability to evaluate their own and others recognition performance, and how this ability is affected by task experience.

Materials and Methods. Kindergartners ( $M = 6$  years) and 2<sup>nd</sup> graders ( $M = 8$  years),  $n = 193$ , studied the meaning of Japanese symbols (called Kanji), study time was fixed. After study they completed the recognition test (select one of four pictures that showed the Kanji meaning), and then gave credit to their own recognition responses and to another child's recognition responses. All children participated in two sessions separated by a week.

Results. When crediting, the 2<sup>nd</sup> graders more accurately discriminated between correct and incorrect recall than kindergartners. Both age groups gave less credit to others than to their own recognition responses. Repeated experience with the task increased credits children gave for own recognition; credit given to the other remained stable.

Conclusions. Findings imply that inaccurate crediting is not only due to children's metacognitive deficits when evaluating learning. Both a wishful thinking bias and repeated experience with the task seems to lead to more overconfidence when crediting one's own incorrect responses, but not when crediting others.

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### **Retrieval-Induced Forgetting Reduces Emotional Strength of Autobiographical Memories.**

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How an autobiographical memory is told may alter its later phenomenological qualities. Here we examine how one mechanism, retrieval-induced forgetting (RIF), influences perceived emotional strength when an inhibited memory is subsequently reinstated. In the standard RIF paradigm, selective recall of target items leads to unpracticed, closely associated items to become less accessible on future recall than similarly unpracticed, but unassociated items (Anderson, Bjork, & Bjork, 1994). The typical explanation for this counterintuitive but highly robust finding is that the unpracticed, associated items present response competition during an act of retrieval, and so are inhibited (Storm & Levy, 2012). Inhibited items become less accessible than mere decay would predict. Barnier, et al. (2004) extended the (RIF) paradigm from category-exemplar word lists to autobiographical memories, and found that selective retrieval practice can inhibit autobiographical episodes. Here we examined the phenomenological consequences of such inhibition, specifically, whether inhibited memories become less emotionally intense when later reinstated. Replicating Barnier, et al.'s (2004) methods, we collected 32 autobiographical episodes associated by nine emotion category cues, and had participants selectively recall half of the episodes from half of the categories. We replicated the previous finding that this method induces (RIF). As a novel contribution, we collected self-report measures of emotionality for each memory before and after selective practice. As predicted, memories that had been inhibited via (RIF) were experienced as emotionally weaker, even when the memory was fully reinstated. We discuss implications for PTSD and understanding mechanisms underlying emotional resilience.

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### Confidence in Recognition Tests: What Underlies the Ratings?

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On two-alternatives forced-choice (2AFC) episodic memory tests, people are sometimes asked to rate their confidence in the chosen answer. The question remains, however, what drives these confidence ratings. The strength account suggests that it is simply the strength of the chosen alternative that underlies the confidence rating, so that the higher the strength, the higher the assigned rating. The difference-in-strength account predicts that it is the difference in strength between the two presented alternatives that matters: the greater this difference, the higher the confidence rating for the chosen word. In six experiments using word lists in the plurals paradigm we directly compared these two potential bases of confidence to discover which is used in 2AFC recognition tests. We found that the strength of the chosen word influenced confidence ratings, as the strength account would suggest. However, the strength of the rejected word also exerted influence on confidence in chosen answers, although the direction of this effect was opposite to that predicted by the difference-in-strength account: confidence was higher when the rejected word was stronger. We discuss the role of recollection in determining confidence ratings on 2AFC memory tests.

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### Does Retrieval Intentionality Really Matter? Similarities and Differences between Involuntary Memories and Directly and Generatively Retrieved Voluntary Memories.

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Theories of autobiographical memory distinguish between involuntary and voluntary retrieval as a consequence of conscious intention. Another distinction can be made between direct and generative retrieval, which reflects the effort involved. However, it is unclear how intention and effort interacts. For example, involuntary memories and directly retrieved memories have been used interchangeably in the literature to refer to the same phenomenon of effortless, non-strategic retrieval. More recent theoretical advances suggest that they are separate types of retrieval, one unintentional (involuntary), another intentional and effortless (direct voluntary retrieval), and a third intentional and effortful (generative voluntary retrieval). Whether this also entails differing phenomenological characteristics, such as vividness, rehearsal or emotional valence, has not been previously investigated. In the current study, participants (60 participants,  $M_{age} = 21.85$ ,  $SD = 1.58$ , range 19-25 years) reported memories in an experimental paradigm designed to elicit voluntary and involuntary memories (Schlagman & Kvavilashvili, 2008) and rated them on a number of characteristics. If intention affects the retrieval process, then we should expect differences between the characteristics of involuntary and directly retrieved memories. Our results imply that: (1) retrieval intention seems to differentiate how a memory appears in

a person's mind, (2) involuntary memories should not be described only by reference to cognitive effort, but also to the lack of intention during retrieval, (3) direct and generative voluntary memories are different from each other and may represent two forms of voluntary remembering. Furthermore, we argue that differences in part could result from differences in encoding and consolidation.

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### Methodology

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### Bayesian Methods to Estimate Multidimensional Item-Response Models: A Comparison of Analytic and Simulation Algorithms.

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Multidimensional item-response models apply to the investigation of the latent dimensionality underlying psychological tests and questionnaires composed of dichotomously scored items, or items responded with few categories. We compared the performance of two estimation algorithms of new usage, the Metropolis-Hastings Robins-Monro (MHRM) and the Hamiltonian MCMC (HMC), with two consolidated algorithms in the psychometric literature, the marginal likelihood via EM algorithm (MML-EM) and the Markov chain Monte Carlo (MCMC), in the estimation of multidimensional item-response models of different latent complexity. The parameter recovery was evaluated via two simulations from a Bayesian approach. The first simulation compared the MHRM algorithm with MML-EM and MCMC in the estimation of an item-response model with a moderate number of dimensions. The second simulation tested the performance of the MHRM, HMC, MML-EM and MCMC algorithms in the estimation of an item-response model in a highly dimensional latent space. The results showed that the four algorithms recover the true parameters with similar precision, and the main differences between them were: 1) estimation time was much more shorter for MHRM than for the other algorithms, 2) MCMC and HMC recovered with more precision the slopes of the complex model than MML-EM and MHRM, and 3) prior distributions for the slopes in the MCMC and HMC algorithms should be carefully defined in order to avoid problems of factor orientation. In conclusion, the new algorithms seemed to overcome the difficulties of the consolidated ones, converging faster and more easily. Email: Manuel Martin-Fernandez, [manuel.martin@inv.uam.es](mailto:manuel.martin@inv.uam.es)

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### A Language Probabilistic Method for Automatic Evaluation of Constructed Response.

ALEJANDRO MARTÍNEZ MINGO, *Instituto de Ciencias Forenses y de la Seguridad (Universidad Autónoma de Madrid)*, RICARDO OLMOS ALBACETE, *Universidad Autónoma de Madrid*, GUILLERMO JORGE-BOTANA, *Universidad Nacional de Estudios a Distancia*, J. ANTONIO LEÓN, *Universidad Autónoma de Madrid*.

The use of automated techniques on evaluation tasks is gaining great weight in the scientific community in recent years. Two computational linguistic models are studied in this work: LSA (Latent Semantic Analysis) and CTM (Correlated Topic Model).



Both are vector-based models of language representation. While LSA is the classical model based on frequencies, CTM represents a novel model and focuses on probabilities of occurrence of words in context. Both linguistic models undergo evaluation summaries of 78 high school students on an expository text. For this purpose, it is verified that both models accommodate a rubric evaluation of these summaries prepared by expert judges. The external criterion used for the assessment the quality of evaluations of linguistic models was the evaluations of these summaries by expert judges. The aims of this paper are: a) to consider whether the new model CTM improves the quality of the assessments against the classical model; b) to check that both models are able to accommodate the rubric of experts. The results show that CTM slightly improves the quality of evaluations and both models use the rubric of experts properly, we can observe correlations of .79 and .83 by using LSA and CTM models respectively, with assessment of expert judges.

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### Neural Mechanisms

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#### Brain Signatures of the Explicit Validation of Sentential Truth-value.

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By capitalizing on a modified version of the classical sentence verification task (e.g. Fischler et al., 1983), this ERP study investigated the neural processes underlying the explicit validation of propositional truth-value. In this new version of the task, truth-value and semantic/associative processes were disentangled by using categorial quantifiers, which allowed us to include the same subject and predicate nouns in sentences that, on the other side, varied in truth-value and polarity form: "Some trees are pines" (true affirmative, TA), "Not all trees are pines" (true negative, TN), "All trees are pines" (false affirmative, FA), and "No trees are pines" (false negative, FN). The major result revealed an ERP effect of truth-value at ~ 436–596 ms following the onset of the last sentence noun: true sentences elicited larger centro-parietal positivity (CPP) than false sentences regardless of sentence polarity form. Spatial transformations (scalp Laplacian and LAURA sources estimation) improved further the interpretation of this electrophysiological effect, by highlighting features in the data that were not visible from raw ERP waveforms. More specifically, they brought to light the contributions to the CPP effect of sources at both middle posterior parietal cortex (mPPC) and right anterior temporal lobe (rATL), involving thereby the conjoint action of both decision and semantic processes. This finding is discussed regarding prior reports on N400 modulations by propositional truth-value (e.g. Nieuwland, 2015) and similar ERP signatures (P3b) linked to decision and categorization processes.

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#### Personal Identity and Emotional Expressions as Clues for Interpersonal Cooperation: An fMRI Study.

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Personal identity and facial emotional expressions serve as cues to make assumptions about the most likely behavior of other people during interpersonal interactions. These inferences can also interfere among them when they lead to opposite predictions. In two different experiments, we explored the neural mechanisms underlying the use of either of these two clues as relevant sources to guide cooperative decision-making. Participants played a modified Trust Game with cooperative and non-cooperative alleged partners, who displayed facial expressions of happiness or anger, and/or had different cooperative tendencies according to their identity. Behavioral data showed the existence of conflict originating from the ignored emotional expressions. fMRI data showed that congruent situations activated the fusiform gyrus while incongruent interactions engaged the anterior cingulate and medial frontal gyrus, indicating an unavoidable influence of emotional information on identity-guided decision-making. In a second experiment, we employed a mixed design to discriminate between sustained and phasic control mechanisms and explore the role of these networks in representing the two types of interpersonal cues and solving the conflict between them.

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#### Control Mechanisms Underlying Instruction-Guided Behavior.

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Humans have the ability to follow verbal instructions and translate them into coherent behaviors, avoiding trial-and-error learning. This highly adaptive behavior is thought to be underpinned by a wide fronto-parietal control network. However, the brain areas involved in specific parts of this complex process, and the cognitive mechanisms that they implement are still unclear. Likewise, the role of sustained control processes that instantiate the context across several instructions remains unknown. To explore the first issue, we conducted a fMRI study in which participants had to implement different instructions, manipulating their experience with them (new vs practiced) and the category of the stimuli they referred to (faces vs letters). Whereas univariate analyses replicated previous findings, multi-voxel pattern analysis (MVPA) revealed different areas that were sensitive to the content of the instructions during the three stages of processing studied (encoding, preparation and implementation). In a second study, we used an adaptation of the task in a mixed design to explore sustained control signals through task blocks. Preliminary results show that Default Mode Network's regions maintain their activity across previously practiced instructions, while blocks of new instructions recruit the aforementioned fronto-parietal network. Overall, our results provide insights about the complexity of the studied process: when using verbal instructions, several brain networks and cognitive mechanisms are involved at different time scales, aiding in the implementation of fast, novel behaviors adapted to a changing environment.

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(100)

### Transcranial Direct Current Stimulation in Word Production: A Failure to Replicate.

JOSHUA S. PAYNE, MARIE-JOËPHE TAINURIER, *Bangor University.*

Transcranial direct current stimulation (tDCS) applied to both inferior frontal and superior temporal regions has been shown to modulate naming responses although the reliability of these effects has recently been questioned. There is considerable variability in the methodology of different studies and key variables, such as whether the same stimuli were tested across conditions, are often not reported. In addition, the specificity of tDCS is unclear as few studies have directly compared stimulation sites. In the present study we attempted to replicate facilitation of naming responses during/following anodal tDCS relative to sham, in a group of healthy young adults. We applied 20mins of 1.5mA tDCS to left inferior frontal (N = 14) and superior temporal regions (N = 14), in order to assess possible site-dependent modulation of naming responses. In addition, we tested whether tDCS effects facilitated practiced items only or generalized to new carefully matched picture-naming stimuli. Despite robust repetition priming effects, we observed no effect of anodal tDCS at either stimulation site or in any of the conditions. Our study highlights the need for further work to clarify the conditions under which tDCS effects are likely to be observed.

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### Sensation and Perception

(101)

### Background Color Modulates Perception of an Illusory Blue in Mediaeval Mural Paintings... And in a Stroop Task.

SAMUEL BROCKBANK-CHASEY, STEPHANIE MATHEY, *University of Bordeaux* FLOREAL DANIEL, *Bordeaux Montaigne University*, SANDRINE DELORD *University of Bordeaux.*

This study investigated interaction between low-level perceptive effect and activation of color representation on color categorization. Colorimetric analysis of illusory blue found in various medieval mural paintings has shown the pigment was in fact grey (flat reflectance spectra and central coordinates in  $L^*a^*b$  color space). However, 40% of observers named these surfaces as "blue" in a color naming task. This illusion could partly be due to contrasting yellow colors adjacent to the grey in the paintings. A stroop task was adapted to further investigate the automaticity of the illusion. Participants were divided into a blue or grey group according to their color naming response. They were presented with three words, YELLOW, RED and BLUE (or GREY depending on the group), written using 15 exemplars of grey, yellow and red color samples taken from the paintings. Stroop words were presented on a neutral (white) or a yellow background. Hence the grey pigment was associated in the congruent word BLUE or GREY for the blue or grey groups, respectively. Results for the grey ink showed 1/ a significant congruency effect both for blue and grey groups and 2/ shorter mean response times for the yellow than for the white background in both groups, and 3/ a modulation of the congruency effect by the background color for the blue group only. Therefore, the grey color could be automatically and indifferently associated with a blue or grey color representation, but still remained sensitive

to perceptive manipulation, such as background color contrast.

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### Effect of Gaze Cue on Eye Movements toward Sequentially Presented Face Images in Autism Spectrum Disorders.

TAKAO FUKUI, MAKOTO WADA, *Research Institute of National Rehabilitation Center for Persons with Disabilities.*

Autism spectrum disorders (ASD) have deficits in social communication and previous studies demonstrated that their gaze behaviors have different spatio-temporal patterns from those of typically developing (TD) peers. Here, eye movements toward sequentially presented face images with or without gaze cues were recorded to examine whether the ASD could perform the task in a prospective manner according to the cues. Participants (ASDs and TDs) were seated comfortably on a chair in front of a laptop PC and the distance between the eyes and a screen was approximately 60 cm. Each line-drawn face image ( $= 257 \times 221$  pixels) was sequentially presented for one second on a laptop PC (14 inch, screen resolution =  $1280 \times 720$  pixels). The number of potential presentation positions was 15 (i.e.,  $5 \times 3$ ), and the face images shifted from side to side and up and down. Two conditions were tested; 1) the gaze of face image was directed to participants, 2) the gaze of face image was directed to the position where the next face would be presented. Participants were required to track the moving face images without instructing the specific parts where they should fixate. We found that the ASD participants less looked at the eyes area in the face image but could shift their gaze earlier using the cue, suggesting the ability to use the social cue, to some extent, for the efficient tracking performance.

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### Adjust Your View! Wing-Mirror Settings Influence Distance Estimations and Lane-Change Decisions.

JOCHEN MÜSSELER, CHRISTIAN BÖFFEL, *RWTH Aachen University.*

To perform lane changes in traffic safely, sufficient distance to the subsequent vehicles is required. In the present study static photographs of traffic situations were presented, in which the subsequent vehicle was seen through the left wing mirror. Distance estimations to the vehicle (Experiment 1) and lane-change decisions (Experiment 2) were gathered in dependency of different wing-mirror settings: Varying the vertical setting resulted in low and high car positions in the mirror and varying the horizontal setting make the driver's own back door visible or not. Findings showed that a visible back door and a low vertical position of the vehicle lead to smaller distance estimations and more cautious lane changes. Consequently, wing-mirror settings are important for traffic safety.

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(104)

### Electrical Stimulation Over Occipital Cortex Improves Visual Acuity.

ROBERT M. G. REINHART, WENXI XIAO, LAURA MCCLENAHAN, GEOFFREY F. WOODMAN, *Vanderbilt University*.

Visual acuity (i.e., the clarity of vision) is dependent on optics and neural factors. Currently, the sharpness of the retinal focus within the eyes can be improved with corrective lenses or surgery, but we lack methods for improving visual acuity at the level of the brain. Here, we show that the precision of spatial vision can be controlled in a bidirectional and causal manner through the noninvasive manipulation of cortical activity. After continuously delivering direct current over occipital cortex for twenty minutes, we observed improvements in subjects' visual acuity. In contrast, by reversing the direction of current flow, we could impair visual acuity. We verified that these behavioural changes were due to differences in activity of the visual system by showing that the earliest visually evoked potentials increased their amplitude in step with behavioral effects. Finally, we found that this stimulation protocol could improve performance on the Snellen chart, the gold standard for measurement of visual acuity in clinical practice. Subjects with the poorest Snellen acuity benefited most from the stimulation, demonstrating the translational potential of these findings for individuals with vision deficits. Email: Robert Reinhart, [robert.reinhart@vanderbilt.edu](mailto:robert.reinhart@vanderbilt.edu).

(105)

### The Ball Vanishes in the Air: Can We Blame Representational Momentum?

CYRIL THOMAS, ANDRE DIDIERJEAN, *Université de Franche-Comté*.

In the past 10 years, research in psychology has been applying today's knowledge to study the processes at play in magic. A classic trick studied in psychology is the *Vanishing Ball Illusion* (VBI). In the VBI, the magician throws a ball up into the air twice, and then pretends to do a third throw. On the third (fake) throw, the audience sees the ball go up and then disappear. In this article, we study the psychological mechanisms at play in this magic trick. We test the hypothesis that the illusion is based on representational momentum (RM), a psychological phenomenon in which the observer perceives the stopping point of a moving scene as being located farther ahead in the direction of motion than it really is. In order to determine whether the mechanisms involved in VBI are similar to those underlying RM, we compare the results in a standard VBI task to those obtained on an RM task designed to be very close to the VBI task (forty-two French students (mean age: 20 years, SD: 1.13) participated in the experiment). The results showed that VBI sensitivity was not associated with a higher anticipation score on the RM task. Unexpectedly, we found that participants who were sensitive to the illusion even obtained a weaker RM effect. We discuss several hypotheses that might account for these results. E-mail: Cyril Thomas, [cyril.thomas@univ-fcomte.fr](mailto:cyril.thomas@univ-fcomte.fr)

(106)

### A Spanish Version of the Test of Ability in Movement Imagery (TAMI).

C. ALEJANDRA VARGAS, EMILIANO DÍEZ, ALBA PLA; ÁNGEL FERNÁNDEZ, ANTONIO DÍEZ, *Universidad de Salamanca*, MA. ÁNGELES ALONSO, *Universidad de La Laguna*.

The need to estimate motor imagery ability is important for several research areas (e.g., embodied cognition, sports and clinical research) and has led to the development of several questionnaires to evaluate it most of them based on subjective ratings of vividness of mental images or imagined movements. But previous research has shown that this kind of ratings are prone to be influenced by other factors such as motor skill confidence or emotional states. For that reason, new assessment instruments have been recently developed, based on objective measures, as a way to overcome this influence. The main goal of this study was to adapt these instruments to the Spanish language and to obtain preliminary information about the psychometric properties of the Test of Ability in Movement Imagery (TAMI), a test that requires participants to make explicit imagined movements from an external perspective. The adaptation was carried out from a paper and pencil English version of TAMI. The test was translated and then administered to a sample of 160 Spanish-speaking university students. Classical test theory analysis showed a poor internal consistency. And the results of item analysis, together with the results of an exploratory factor analysis, suggest the introduction of some changes in the mode of administration (e.g., randomization of item presentation) of the test that could result in the improvement of its psychometric properties. E-mail: C. Alejandra Vargas de la Cruz [alex\\_vc@usal.es](mailto:alex_vc@usal.es) *Universidad de Salamanca*, Salamanca, Spain; *Universidad de La Laguna*, Tenerife, Spain

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### Object Substitution Masking across Saccadic Eye Movements.

FILIP GERMEYS, BART MICHIELS, MAARTEN DEMEYER, KARL VERFAILLIE, *Laboratory of Experimental Psychology Leuven*.

Visual perception occurs through feed-forward as well as feed-back networks in the visual cortex. One psychophysical paradigm that has enriched the understanding of these processes is object substitution masking (OSM). A target stimulus and a non-overlapping mask (four dots surrounding the target) are briefly presented simultaneously with several distractor stimuli (without a mask). After a short interval, all stimuli apart from the target mask disappear and the mask persists for a specific duration (trailing mask duration or TMD). Identification performance drops with increasing TMD. While an extensive literature exists on OSM within fixations, it has not yet been investigated across saccades (that cause a temporal and spatial discontinuity in the input). In the present study we investigate whether OSM also occurs transsaccadically.

CENTRAL HALL,  
SATURDAY 7TH MAY, 10:00-12:40  
POSTER SESSION III

### Attention and Performance

(1)

#### The Effects of Control Deprivation and Restoration Experiences on Cognitive Flexibility.

MARCIN BUKOWSKI, *Jagiellonian University*, JUAN LUPIÁÑEZ, SOLEDAD DE LEMUS, *University of Granada*, ANNA MARZECOVÁ, *Leipzig University*.

In this research we examined how the dynamics of personal control loss and restoration influences the flexibility of switching between social categories. Previous research showed that stable and prolonged experience of control deprivation impairs selective attention and the efficiency of attentional control. Data from two experiments will be presented, in which we investigated whether unstable and short-term experiences of control loss and restoration can actually stimulate executive attention leading to a boost in cognitive flexibility. We manipulated the experience of personal control by changing the number and sequential order of solvable and unsolvable tasks in the *Informational Helplessness Training* paradigm. We measured cognitive flexibility after control deprivation using the *Social Category Switching Task*, in which participants were asked to categorize human faces based on their gender or age (Experiment 1) and a *Gender Role Switching Task*, in which participants categorized human faces presented in different work-related contexts based on gender and social role (congruent or incongruent with a stereotype; Experiment 2). The results of both studies revealed that when control was deprived and next restored, participants showed lower costs of switching between social categories than in stable uncontrollability conditions. Potential mechanisms underlying the effects of different experiences of lacking personal control on cognitive flexibility in social contexts are discussed.

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(2)

#### Does the Relationship between Aerobic Fitness and Sustained Attention Depend on Task Demands?

LUIS F. CIRIA, CRISTINA MORATO, ANTONIO LUQUE-CASADO, PANDELIS PERAKAKIS, DANIEL SANABRIA, *University of Granada*.

A growing set of studies has indicated the existence of a positive relationship between physical activity and sustained attention capacity or vigilance, although the precise nature of that relationship is far from clear. The purpose of this study was to investigate the role of task demands on the relationship between sustained attention and fitness. Forty-four young adults (18-23 years) were divided in two groups as a function of the level of aerobic fitness (Higher-fit [HF] and Lower-fit [LF]). Participants completed the Psychomotor Vigilance Task [PVT] and an Oddball task where they had to detect infrequent targets presented among frequent distractors. Nonparametric permutation tests showed faster responses for the HF group than for the LF group in the PVT. In the Oddball task,

the LF group showed a decline of target detection over time, while the HF group maintained accuracy throughout the task. The PVT results replicated previous accounts from our laboratory, suggesting greater sustained attention capacity of HF young adults with respect to LF. Importantly, the results of the oddball task seem to suggest that the better sustained attention capacity of HF young adults was not related only to a faster motor reaction but also to an enhanced capacity to detect and process the relevant information.

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(3)

#### A Bias for Local Processing in Parents of Autism Spectrum Disorder Children.

MACARENA CONESA, *Universidad de Málaga*, ALEJANDRO J. ESTUDILLO, *University of Kent*, JAVIER GARCÍA-ORZA, *Universidad de Málaga*.

According to the central coherence account, people with Autism Spectrum Disorders (ASDs) have a cognitive style that makes them to rely more on local rather than on global processing. (Frith, 1989; Happé y Frith 2006). The present research explores whether this cognitive style is also evident in parents of ASD children who do not show clinical diagnosis of this pathology. Ten parents of ASD children and 10 healthy controls matched in IC and age participated in three experimental tasks: a block design test—which relies on local processing—a face composite processing task—a standard face test of global face processing—and a sentence completion task—which requires global coherence—. Our results indicate that ASD parents performed better in the block task than the age matched controls. In addition, the face composite task showed that ASD parents were worse integrating facial stimuli in a global level. These results suggest that a bias for local over global processing is also part of the broad autism phenotype.

(4)

#### Context-Specific Proportion Congruent Effects for Frequency Unbiased Items: Novel Extensions and Analyses of Reproducibility.

MATTHEW J. C. CRUMP, *Brooklyn College of the City University of New York*, NICHOLAUS BROSKOWSKY, *Graduate Center of the City University of New York*.

Crump & Milliken (2009) showed that Stroop effects can be modulated by context-specific cues associated with different levels of proportion congruent, even for items that appeared equally frequently in each context. This result has important theoretical implications, because it ruled out frequency-driven learning explanations of context-specific proportion congruent (CSPC) effects, and left open the possibility that cue-driven retrieval process can reinstate attentional control setting in a rapid online fashion. The purpose of the present work was to address reproducibility concerns that have been raised about this finding. We conducted several replications and novel extensions of the Crump & Milliken procedures using Amazon's mechanical Turk in both Stroop and



flanker tasks. We successfully replicated the major findings from prior work, and conducted new analyses of the role of sequential influences on CSPC effects that showed a critical role for context repetitions in CSPC flanker effects, but not in CSPC Stroop effects. We also provide new monte-carlo simulation analyses to estimate reproducibility of the phenomena that show important limitations on these designs for measuring contextual control.

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(5)

### Comparing the Role of Selective and Divided Attention in the Composite Face Effect.

DANIEL FITOUSHI, *Ariel University*.

Composite faces combine the top half of one face with the bottom half of another to create a compelling illusion of a new face. Evidence for holistic processing with composite faces comes primarily from a matching procedure, and is confined to selective attention tasks. The present study employed a dual-task approach to study how observers divide their attentional resources across the composite faces halves. In particular, the Attention Operation Characteristic method (AOC, Sperling & Melchner, 1978a, 1978b) was used. In this method AOC curves are constructed by plotting the performance measure of the top half against performance measure of the bottom half. AOC plots revealed that top and bottom halves were sharing attentional resources, and did so in comparable fashion with both spatially aligned and misaligned configurations. Cross contingency analyses (Miller & Bonnel, 1994) showed that, at the within-trial level, the constituent halves were processed independently of each other. Overall, the results converged on the following conclusions: (a) the interaction between composite face halves is due to attentional limitations, not due to switching or fusion strategies, and (b) the processing of aligned and misaligned composite faces is quantitatively and qualitatively similar. Taken together, these conclusions challenge the holistic interpretation of the composite face illusion. Email: Daniel Fitousi, [daniel@ariel.ac.il](mailto:daniel@ariel.ac.il)

(6)

### Comparing Lure Effects in Working and Long Term Memory in Visual Search.

BEATRIZ GIL-GÓMEZ DE LIAÑO, *Universidad Autónoma de Madrid*, TRAFTON DREW, *University of Utah*, DANIEL F. RIN, *Universidad Autónoma de Madrid*, JEREMY M. WOLFE, *Harvard Medical School & Brigham and Women's Hospital*.

There is strong empirical evidence that Working Memory (WM) representations bias selection in attentional processes (Soto & Humphreys, 2014). However, only a few studies have examined whether attentional guidance in visual search can be biased by the contents of Long-Term Memory (LTM) (e.g. Olivers et al., 2011). The present work is the first to directly compare the degree to which items in LTM and WM capture attention in a visual search task. In this study images held in either LTM or WM were sometimes shown as distractors in the visual search task. Those items were "lures" that might attract attention even though this would impair performance because those lures could never be targets. The results replicate previous findings. Lures resulted in significant increases in reaction time whether the lures were items from LTM or WM. Although magnitude of the lure effects was similar with LTM and WM, for LTM the effects only appear in target present trials, while for WM they are present regardless of the target appearance.

Somewhat mysteriously, across several studies we also found that a high working memory load led to faster response times than a low working memory load. Possibly this is analogous to the spatial 'flanker task', where higher loads prevent interference from extraneous material.

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### Searching Here, Searching There: The Effect of Switching between Different Visual Searches.

MARGIT HÖFLER, *University of Graz*, IAIN D. GILCHRIST, *University of Bristol*, ANJA ISCHEBECK, CHRISTOF KÖRNER, *University of Graz*.

Previous research has indicated that memory supports repeated visual search such that search performance improves if the same display is searched consecutively. Here we investigated the extent to which this memory can support two repeated searches that are alternating. In Experiment 1, participants searched an 8 or 12-letter display 90 times for a target that was present on half of the trials. The display was the same throughout the searches (repeated) or changed with each search (unrepeated). Between the individual searches either a blank display was presented or participants had to complete another (different) search. This search was again a repeated or unrepeated search. In Experiment 2, the participants searched (repeated or unrepeated) displays of 10 letters 60 times while their eye movements were measured. Again, the repeated search interleaved with a different repeated or unrepeated search, or a blank or placeholder display for control. The results showed faster searches in the repeated-blank (Experiment 1 and 2) and the repeated-placeholder (Experiment 2) conditions than in all other conditions. When participants had to switch between a repeated search and a different repeated or unrepeated search, search performance decreased to the level of an unrepeated search. Furthermore, search performance improved with repetition of the display only in the repeated-blank and the repeated-placeholder conditions, but not in the other conditions. These findings are further evidence that memory processes support repeated visual search but also suggest that these processes are not sufficient to confer a benefit when a switch between searches is required.

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(8)

### Electrophysiological Evidence of Shared Task Representation on Joint Action.

KIMIKO KATO, KAZUHITO YOSHIKAWA, YUMI KIMURA, *Aichi Shukutoku University*.

A wide range of research has focused on the influence of perceiving others' actions on one's own action and cognition. The so-called mirror neurons fire when a monkey observes an experimenter grasping an object as well as when the monkey performs the same action. Sebanz (2006) argued that the existence of a common coding system for perception and action has implications for many social interactions. To investigate priority of shared task representations (own versus other) formed during joint task performance, event-related potentials were recorded while participants performed an auditory (Experiment 1) and visually (Experiment 2) three-stimulus oddball task alone (individual condition) and with another participant (joint condition). Participants were required to discriminate between frequent standard and rare target, while

ignoring non-targets assigned to a partner's action (i.e., no-go stimuli for one's own task performance). The parietal P3b was elicited for targets in both conditions. In contrast, P3b for non-targets was observed only in the joint condition, and in addition it accompanied the frontal no-go P3. This implies that co-actors share one another's task representations. Importantly, the emergence of P3b and no-go P3 for non-targets was delayed as compared to P3b for targets, suggesting that shared task representations are serially applied to the stimulus processing, and that one's own representations precedes the other's individual's representations.

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(9)

### Suppression Is Smarter Than Previously Thought: Only the Competitor Category Response Rules, Not the Entire Competitor Rules, Are Being Suppressed When Resolving Incongruent Trials.

MAAYAN KATZIR, BNAYA ORI, NACHSHON MEIRAN, Ben Gurion University of the Negev.

In their seminal work on Backward Inhibition, Mayer and Keele (2000) showed that, when switching between tasks, inhibition is being carried over to the next trial. Recently, Meiran, Hsieh and colleagues (2010, 2011, 2012) suggested that response conflicts are being resolved via a more specific inhibitory mechanism, which targets the interfering competitor rule(s) (i.e., an interfering irrelevant rule). Specifically, they found performance cost in Trial N if the relevant task rule in this trial was a competitor rule in Trial N-1. They termed this inhibitory effect Competitor Rule Suppression (CRS), as it indicates that the competitor rule in Trial N-1 was suppressed. By the same logic, we should expect performance benefit when the competitor rule in Trial N-1 remains the competitor rule in Trial N. We term this effect Competitor Rule Repetition (CRR). In this work we address the question whether what is being suppressed when encountering a response conflict (e.g., when having to name the shape of a red circle, and red is mapped to the left key while circle is mapped to the right key) is the entire task rule (e.g., "IF green THEN press right, IF red THEN press left") or an even more specific representation, namely, the currently interfering category response rule (e.g., "IF red THEN press left"). We show that both CRS and CRR interact with Response (i.e., left or right key), suggesting that the system can recognize the exact source of interference, and inhibit only this source, presumably to maximize performance.

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### Modelling Saccadic Reaction Time Data to Study Cognitive Development – Taking a Fresh Look!

CHRISTOPH KLEIN, University of Freiburg, Bangor University, University of Cologne, YOANNA SCHULZ-ZHECHEVA, BERND FEIGE, MONICA BISCALDI, University of Freiburg, ANDRE BEAUDUCCEL, University of Bonn, MANUEL VOELKLE, Humboldt University Berlin.

**Objectives/Introduction:** The anti-saccade task has been widely used to study cognitive processes as well as their development and individual differences herein. Despite this wide range of applications, this task's major parameters, saccadic RT and error rates, have been modelled relatively simplistically so far. Therefore the present study aims to test the usefulness of established models

of RT for the modelling of saccadic RT data. **Methods:** We apply diffusion and ex-Gaussian models of RT to pro- and anti-saccade data of N=203 participants aged 6-28 years to model developmental and experimental task effects. **Results:** Performance in the anti-saccade task was characterized by increased ex-Gaussian  $\mu$  and  $\sigma$ . Diffusion model drift rate, its variability and boundary separation were decreased in the anti-saccade task while non-decisional time, its variability and variability of starting point were increased when compared to the pro-saccade task. Higher age was associated with lower ex-Gaussian parameters and variability of non-decisional time as well as higher drift rate. **Conclusions/Discussion:** The present application of established RT models to saccadic RT data revealed not only satisfactory model fits, it also yielded a more differentiated picture of the anti-saccadic task effect and possible developmental differences herein. The use of such models for analysing saccadic RT data is thus recommended.

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(11)

### Irrelevant Color Grouping Improves Attentional Selection in Partial Report.

RASMUS LUNAU, THOMAS HABEKOST, University of Copenhagen.

Perceptual grouping is the involuntary and effortless grouping of elements with similar features. It is known to modulate performance in attention tasks such as visual search and change detection. In the present study, we investigated whether grouping of targets by a task irrelevant feature influences performance in the partial report paradigm. In this paradigm, participants must report as many target letters as possible from a briefly presented circular display. Some trials included digit distractors (partial report), and the crucial manipulation concerned the color of elements in these trials. Sometimes, the color of the display elements was arranged according to the selection criterion (organized condition), and sometimes color was randomly assigned (scrambled condition). Distractor cost was inferred by subtracting performance in partial report trials from performance in trials with no distractors (whole report). In five experiments, we manipulated trial order, selection criterion and exposure duration, and found that attentional selectivity was impaired in scrambled trials when the exposure duration was 200 ms and the distractors were digits. This effect was accompanied by improved selectivity in organized trials with the same exposure when targets were defined by luminance. Overall, the results demonstrate that task irrelevant color grouping of targets can improve attentional selection in brief search displays.

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(12)

### Effect of Rugby Expertise on Contextual Cuing.

ALEXIS DEFER, Université Paris-Saclay and Université de Rouen, ANNABELLE GOUJON, Université Bourgogne Franche-Comté, ANDRÉ DIDIERJEAN, Université Bourgogne Franche-Comté and Institut Universitaire de France, FRANÇOIS MAQUESTIAUX, Université Bourgogne Franche-Comté.

Since the first study on contextual cuing by Chun and Jiang (1998), numerous studies have investigated the learning of contextual regularities while searching for a visual target. Here, we tested experts and novices in rugby, using a contextual cuing task for which the goal was to search for a letter T among an array of





letters L positioned against a background of a scene taken from either a rugby game or an everyday life situation. In the experiment carried out, the scenes and the L distractors were repeated and the target location was always the same for half of the scenes (predictive condition) but was systematically varied for the other half (unpredictive condition). At the end of experiment, we tested the explicit awareness of target location. Results showed that contextual cuing effects were larger for rugby experts relative to novices, only when the background was relevant to the domain of expertise. We will discuss the findings in terms of the relationships between the development of awareness and expertise.

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### **How to Measure the Memory Consequences of Prediction Error at a Basic Level: Evidence from a Validity Paradigm.**

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A common hypothesis in the field of learning is that unpredicted events have an important role on the acquisition of new information. Things which are already well known are, by definition, not very informative and thus they do not need to be fixated in memory (again). To test this hypothesis researchers have often used very complex designs in which predictions are established based on predictive sequences or contexts that anticipate the presentation of certain stimuli. Nevertheless, these paradigms fail to isolate the more basic cognitive processes. In our lab, we intended to explore the role of attention on this prediction-mediated learning. We used a much simpler validity task to generate a spatial expectation. Here we present a series of experiments that thoroughly manipulates the type of cue (endogenous vs exogenous), the stimulus processing (superficial vs deep), the number of presentations (one to five) and the type of memory (remembering vs knowing). Participants had to respond to series of words that could appear in valid, invalid or neutral locations. Later a surprise recognition test was administered. Results from different experiments are put together and show that many of these factors have a crucial impact on memory for the presented words and that without careful control over the stimulus set and the task variables is not possible to draw strong conclusions. We will also discuss our findings in the light of classic and recent research.

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### **Panorama of Phenomenal Selves: Supplemental Evidence from Cognitive Self-Presentation among Clinically-Selected Nigerian Undergraduates.**

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**Introduction:** The study aimed at investigating the effects of self-presentation, depression and gender on the phenomenal self, in an attempt to partially replicate Rhodewalt and Augustsdottir's (1986) work on self-presentation. Participants were 144 introductory psychology students of the University of Uyo, Nigeria. The independent variables were self-presentation, depression and gender while the dependent variable was the phenomenal self-measured through participants' self-esteem.

**Method:** Participants who were randomised into eight experimental groups completed the Symptoms Checklist, a depression screening scale, and The Tennessee Self-concept Scale before participating in a role-playing experiment involving scenarios of self-enhancement and self-deprecation. A post-test of depression and self-esteem followed the experimental session.

**Results:** Results from 2x2x2 ANOVA showed that self-presentation and gender had significant effects on self-esteem while depression showed no significant effect. Main and sifted interactions through multiple comparison indicates that self-construal is a function of individual difference factors in various dimensions and combinations.

**Conclusion:** The present findings further confirms the malleability of the self-concept with inherent real life implications on various levels of group behaviour, especially the projection of desirable and undesirable self-images. It is therefore important for social models and significant others such as parents, teachers and counselors to monitor life scenarios where learners may be influenced through negative self-constructions.

**Keywords:** Cognitive Self-presentation, Phenomenal self, Panorama, Nigerian Undergraduates, Supplemental evidence  
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### **Gauging Levels of Optimality in Collaborative Visual Search.**

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Collaborative visual search requires multiple observers reach a joint decision. However, groups rarely match performance levels predicted by normative models in collaborative cognitive tasks (Kerr & Tindale, 2004). Suboptimal joint decision strategies might explain why some groups fail to achieve their predicted ideal collaborative performance. Which joint decision making strategies do collaborative searchers rely on and what limits them from achieving statistically ideal performance? We compared the empirical performance of two person teams in signal-detection based visual search tasks to various decision-making models' predictions of optimal performance. In three experiments, 16 pairs of adults had to decide whether displays contained a target or not. In Experiment 1, participants searched for one of a possible five knife targets in a series of x-ray baggage images. Group performances approached the predictions of a statistically optimal model. Experiments 2 and 3 used a simulated medical decisionmaking

scenario. In Experiment 2, targets were presented for either short or longer exposure durations to see how group performance might change over time. Group performance matched a model that assumed the performance was dominated by the more sensitive member of each team. There was no evidence to suggest that exposure durations influenced group performances. Experiment 3 replicated this result in a free viewing search task.

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### Prioritized Items Are More Susceptible to Perceptual Interference: Evidence from Mean Differences, Inter-Individual and Intra-Individual Correlations.

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Evidence from studies of attentional prioritization in visual working memory suggests that this boosts recall of the selected items while making them more susceptible to perceptual interference caused by a visual 'suffix' (Hu et al., 2014). We further tested this hypothesis by manipulating the degree of prioritization. Specifically, we asked the question whether participants who were instructed to pay attention to more than one item would show an even greater degree of suffix disruption when compared to non-prioritized items. This prediction was confirmed by a series of analyses of mean differences and of inter-individual and intra-individual correlations. Hence, increasing the number of items to be prioritized led to an improvement in recall for these items, but also an increase in overall vulnerability to suffix interference. Furthermore, those participants who showed larger prioritization effects also showed increased susceptibility to suffix effects. These results support the view that paying specific attention to items in visual working memory enhances their accuracy at the cost of increasing their susceptibility to perceptual interference.

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### Complex Cognition

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### Fast Logic? Examining the Time Course Assumption of Dual Process Theory.

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Highly influential dual process theory of reasoning and decision making assumes that logical answer for a given problem can be generated by deliberative System 2 processing only. We tested whether a logical response to classic reasoning and decision making tasks (bat & ball problem, syllogistic reasoning, base rate bias) is only generated following slow, deliberative, System-2 processing. We used a two response paradigm in which participants have to give an immediate answer and afterwards are allowed extra time before giving a final response. In five experiments (N=648) we used a range of procedures (e.g., time pressure, concurrent load) to make sure that the initial response was truly intuitive in nature. After analysing accuracy data, reaction times and confidence ratings, we found clear evidence that indicates that logical responding often occurs as a result of fast and automatic System-1 processing.

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### Moral Utility: How Utilitarian Identity Affects Choice Rationality and Latency.

KATARZYNA BILSKA, *University of Warsaw*, PETKO KUSEV, *Kingston University London*.

Do humans think it is acceptable and moral, to sacrifice a life of one person in order to save many other people? Over years, many theorists (e.g., Greene, Sommerville, Nystrom, Darley & Cohen, 2001; Greene & Haidt, 2002; Mikhail, 2007, Mikhail, 2009; Thomson, 1985) have explored the influence of action involvement in hypothetical moral scenarios (personal-footbridge and impersonal-trolley dilemmas) on utilitarian judgments. Obtained results, indicate a tendency for people to judge utilitarian, personal actions to be less appropriate and less moral than equivalent utilitarian, impersonal actions. Greene et al.'s (2001), dual-process theory of moral behaviour predicts that, judging the appropriateness of personal dilemmas (that activate emotional affect) is more cognitively demanding and thus, results in people taking significantly more time to be rational, than in the impersonal moral dilemmas. In one experiment we explored the influence of action involvement, group identity as well attractiveness of the person under moral consideration/decision on choice rationality and decision-making time. Respondents tend to make more rational decisions when presented with moral scenarios involving 'sexually attractive' utilitarian target (as opposed to 'sexually non-attractive'), and they took less time making the decision, but surprisingly more time justifying their rational choice. These are novel findings, not anticipated by existing moral utilitarian theoretical accounts.

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### Feeling of Agency Predicts Choice.

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The feeling that one's actions influence outcomes is known as the feeling of agency. People use cues—such as the actions of others, perceived performance, and personal effort—to infer agency, but we do not know how the feeling of agency affects one's decision to perform a task. We conducted a series of experiments using a simple computer-game paradigm – the space pilot task – to investigate how the subjective feeling of agency affects choice. Participants used the mouse to move a cursor to explode Xs and avoid Os as they scrolled down the screen, a task that resembles the classic Space Invaders video game. We manipulated the feeling of agency by introducing interference into the cursor movement and varying the contingency between hitting an X and observing an explosion. In a replication of prior research, individuals reported feeling less in control in the interference condition and in conditions when objective contingency was less than 100%. A logistic regression analysis showed that while actual performance and subjective judgments of performance predicted choice, judgments of agency had a stronger predictive effect. Individuals were more likely to choose games in which they reported a greater feeling of agency.

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### **Online Warnings Reduce Identity Disclosure, but Disclosure is not Related to Risk Perceptions.**

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Identity theft is an increasing problem, such that people should be cautious when disclosing their personal information online. We developed and tested a model that predicts relations between the disposition to trust, trust beliefs, risk perceptions, attitudes toward a website, and the disclosure of personal information online. To test the model we created a website that asked for personal information in a mock automobile insurance quote context. As participants moved through the website, they were given a warning when asked for personal information. If the participant clicked into the text box to disclose information, a warning appeared: "Hazard! Disclosing this information may be hazardous to your identity privacy." We manipulated the source of the warning (e.g., FBI, Google) and the information requested (email or driver's license). Participants ( $n = 119$ ) answered follow-up questions regarding trust attitudes and risk perceptions. The warnings did reduce disclosure, with the FBI Cyber Division being most effective. Disclosures, however, were not related to disposition to trust, risk perceptions, or trust in the warning source. Taken together, these are important findings. We cannot rely merely on people's ratings of trust or risk in predicting their online disclosure behavior, but should assess people's disclosure behaviors in situ. Our long-term goal is to provide guidance for designers of warnings, to help people be more cautious in their disclosures.

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### **The Influence of Decision Context and Comparability on Judgements of Gain and Loss.**

ALEX COOKE, PETKO KUSEV, *Kingston University London.*

Loss aversion is a psychological phenomenon whereby loss decisions are weighted greater than the equivalent gain decisions (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992). Recent research by McGraw, Larsen, Kahneman and Schkade (2010) revealed that the occurrence of loss aversion relies on psychological measures and scales. Specifically, loss aversion was present only when there was a possibility for comparing losses and gains directly (employing unipolar scales) – contextual comparability. Previous studies, however, explored the variation of risky preferences as a function of psychological comparability (Stewart, Chater & Brown, 2006; Kusev, van Schaik, Ayton, Dent & Chater, 2009; Kusev & van Schaik, 2011). Experiment one was designed to test loss aversion for judgements of feelings with non-monetary and monetary, unipolar and bipolar scales. We found that the mismatch (non-comparability) between perceived decision scenario and judged decision content eliminates loss aversion. Experiment two further explored the psychological comparability hypothesis by controlling for levels of comparability between perceived decision scenario and judged decision content. The results revealed inconsistent loss aversion; psychological comparability (between perceived decision scenario and evaluated decision content) and not contextual comparisons fuelled loss averse judgements.

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### **Feelings of Time: Familiarity and Fluency Effects in Duration Judgments.**

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Familiarity is a fundamental memory-based process that alters our sense of time. The overestimation effect in prospective conditions (i.e., active monitoring of temporal information) has been explained by changes in processing fluency in two different ways: liberation of attention resources to process temporal information (framed in cognitive models of time perception) and feeling of processing easiness that is misattributed to duration (framed in socio-cognitive models of judgment). However literature is absent in testing the plausibility of these models. First, we examined the boundary conditions of this effect in a meta-analysis of 169 experiments ( $N=5182$ ) by testing different moderators with mixed effects categorical models. The critical analysis showed a greater effect when durations are longer (accumulative lost of temporal information) or when differences between durations are harder to discriminate (use of non-temporal information). Although inferential, these findings are congruent with both mechanisms of attention interference and fluency misattribution. To disentangle these mechanisms, we conduct a psychophysiological study using proxies of fluency feelings (positivity: zygomatic activity) and attention (corrugator activity and heart rate) measured during stimuli processing. Subjects ( $N=27$ ) had to estimate the duration (ranging from 400 to 1600ms) of new or previously presented neutral faces. A within mediation analysis showed that zygomatic response (but not corrugator or heart rate responses) is a significant predictor of familiarity effect in duration judgments regardless of stimuli actual duration. In general these findings suggests that feelings could be used to estimate time as a parallel mechanism that is integrated with temporal information processing.

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### **Varieties of Erring: Discerning and Accounting for Individual Differences in Error Detection.**

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Decades of reasoning and decision-making research has established that human judgment is often biased by intuitive heuristics. Recent "error" or bias detection studies have focused on reasoners' abilities to detect whether their heuristic answer is erroneous and conflicts with logical or probabilistic principles. A key open question is whether there are individual differences in this bias detection efficiency and how this affects reasoning performance. Here we present three studies in which co-registration of different error detection measures allowed us to assess bias detection sensitivity at the individual participant level in a range of reasoning tasks. Results indicate that although most individuals show robust bias detection (as indexed by increased latencies and decreased confidence associated with erroneous answers), there are subgroups of reasoners who consistently fail to do so. We discuss implications for the debate on human rationality and popular dual process theories.

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### Visual Aids Improve Diagnostic Inferences and Metacognitive Judgment Calibration.

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Visual aids can improve comprehension of risks associated with medical treatments, screenings, and lifestyles. Do visual aids also help decision makers accurately assess their risk comprehension? That is, do visual aids help them become well calibrated? To address these questions, we investigated the benefits of visual aids displaying numerical information and measured accuracy of self-assessment of diagnostic inferences (i.e., metacognitive judgment calibration) controlling for individual differences in numeracy. Participants included 108 patients who made diagnostic inferences about three medical tests on the basis of information about the sensitivity and false-positive rate of the tests and disease prevalence. Half of the patients received the information in numbers without a visual aid, while the other half received numbers along with a grid representing the numerical information. In the numerical condition, many patients—especially those with low numeracy—misinterpreted the predictive value of the tests and profoundly overestimated the accuracy of their inferences. Metacognitive judgment calibration mediated the relationship between numeracy and accuracy of diagnostic inferences. In contrast, in the visual aid condition, patients at all levels of numeracy showed high-levels of inferential accuracy and metacognitive judgment calibration. Results indicate that accurate metacognitive assessment may explain the beneficial effects of visual aids and numeracy—a result that accords with theory suggesting that metacognition is an essential part of risk literacy. We conclude that well-designed risk communications can inform patients about health-relevant numerical information while helping them assess the quality of their own risk comprehension.

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### Testing Between Serial and Parallel Theories of Recognition-Based Heuristic Decisions.

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In binary decisions involving a recognized and a non-recognized choice option, it is well known that people often go with the recognized alternative. To explain this result, Goldstein and Gigerenzer (2002) proposed the recognition heuristic (RH) as a fast and frugal decision strategy according to which participants immediately choose the recognized object without consideration of any further knowledge. To disentangle pure use of the RH from integration of further information, Hilbig, Erdfelder, and Pohl (2010) proposed and validated the r-model. However, this multinomial processing tree model refers to choice frequencies only and thus does not allow for testing whether RH use is faster than information integration, as predicted by the serial RH model. Therefore, we extended the r-model to account for choices and response times (RTs) simultaneously. We assume that RH use and information integration are mutually exclusive cognitive processes associated with separate, latent RT distributions. Based on this RT-extended r-model, we estimated the speed of RH use and information integration in a distribution-free way using data from eight experiments by Michalkiewicz and Erdfelder (2015).

The results show that RH use is actually slower and not faster than decisions based on integration of recognition-congruent information. This contradicts the serial RH model but is in line with parallel models of global information integration (e.g., the parallel-constraint satisfaction theory, Glöckner & Betsch, 2008) in which reliance on recognition can be modeled as a special case.

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### Exploring the Process of Diagnostic Reasoning: An Eye-Tracking Study.

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When finding a best explanation for observed symptoms a multitude of information has to be integrated and matched against explanations stored in memory. Although process models exist that make assumptions about ongoing memory processes during diagnostic reasoning (e.g., the construction of a situation model consisting of preassigned explanations) little process data exists that would allow to sufficiently test these assumptions. In order to explore memory processes in diagnostic reasoning, 29 participants were asked to solve a visual reasoning task (the Black-Box paradigm) where critical information had to be retrieved from memory and manipulated the appearance of unexplained symptoms. Reasoning processes can be observed by applying memory indexing, an eye tracking method that allows exploring memory processes in complex cognitive tasks by utilizing the human ability to spatially index information held in memory.

Our data reveals that participants fixate lesser and shorter to symptoms over the course of the experiment with their problem solving accuracy remaining at the same level. Together with the fact that participants's visual search becomes more efficient (i.e., less fixations to task-irrelevant locations) this indicates that automation in reasoning process increases over time and with practice. Furthermore, we found evidence that participants look back to preassigned explanations, monitoring the fit between their current explanation and their situation model. This study presents new prospects to assess reasoning processes by combining memory indexing with a visual reasoning task. Our results provide insights into ongoing memory processes during diagnostic reasoning that will broaden our understanding of the reasoning process.

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### Perceived Softness and Positive Affect Hinders Utilitarian Moral Decision.

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Research on embodied social cognition has suggested that one's bodily experiences, especially tangible experiences, are grounded in social relationships. For example, Cushman et al., (2006) showed that physical contact had a significant impact on the permissibility of utilitarian decision—harming or killing one individual in order to save the lives of several others. Participants were less permissible to sacrifice an individual when scenario contained physical contact (e.g., pushing a man) than no physical contact (e.g., pushing a button). Recently, Majima and Nakamura (2015) revealed that touching soft or hard object alters participants' moral dilemma judgment. These





studies suggest that haptic sensation affects our moral decisions. Present study tested whether seeing soft or hard object affect moral dilemma judgment, and explored possible mediating variables, such as emotion, of these processes. We hypothesized that seeing soft objects encourages a sense of physical contact and thus hinders utilitarian decisions. One-hundred fifty seven Japanese participants collected from crowdsourcing service were presented with either images of soft or hard objects, and then asked to choose their actions in eight high-conflict moral dilemma tasks. The results showed that participants who saw soft objects were less permissible to adopt utilitarian actions than those who saw hard objects. We also found a gender difference, where male participants seeing soft object were less prone to utilitarian decision. Furthermore, it was shown that positive affect was negatively associated with utilitarian decisions. These results indicated that embodied moral judgment has multimodal characteristics in nature.

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### **Involvement of Dopaminergic System in Modafinil Reward.**

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Modafinil is a psychostimulant approved for the treatment of narcolepsy and also used as a cognitive enhancer in patients with psychiatric disorders. Recent data suggest that modafinil may have reward effects. However, a possible mechanism of modafinil has not been fully understood. In this study we investigated the rewarding effects of modafinil using the conditioned place preference (CPP) paradigm in mice. In order to address to elucidate possible involvement of dopaminergic modulation in modafinil reward, we observed changes in dopamine, NMDA, and GABA receptor bindings in the mouse brain after treatment with modafinil using radioligand receptor autoradiography. We observed that modafinil significantly produced rewarding effects in mice and prevented normal body weight gain of mice in a dose dependent manner. Significant reduction in normal body weight gain was observed when mice were administrated modafinil. In addition, there were wide changes in receptor binding in the brains of modafinil-treated mice; dopamine D1 binding was increased in the caudate putamen, the accumbens, and the substantia nigra, while dopamine D2 binding was decreased in the caudate putamen and the nucleus accumbens. Dopamine transporter (DAT) binding was increased in the prefrontal cortex, the caudate putamen, and the nucleus accumbens. However, no changes were observed in NMDA and GABAA  $\gamma$ -receptor binding. This data indicates that modafinil has a significant rewarding effect and this rewarding effect of modafinil may be modulated by dopaminergic systems.

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### **Uncertainty in Weather Forecast Phrasing.**

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Decision-making using weather forecasts with uncertainty have vast consequences for health and safety. Yet, little is known about how the framing of forecasts with uncertainty affects decision-

making. Researchers have used Prospect Theory to provide a framework for cognition of forecasts that include Bayesian probabilities. However, Bayesian probabilities and uncertainty in weather forecasting are computationally and contextually different. Our goal was to determine if similar failures of invariance occur in hurricane weather forecasts that include probabilistic and uncertainty phrasing of the same data. Preliminary findings suggest that after reading probabilistic and uncertain forecast phrasing, judgments of hurricane severity were not equivalent. Participants reading uncertainty phrasing rated the hurricane as being more life-threatening and damaging than those that read probabilistic phrasing, demonstrating that phrasing of uncertainty must be considered in weather forecast communication.

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### **Can Numeracy Aid High-Stakes Decisions about Health? A Retrospective Study of Acute Coronary Syndrome Survivors.**

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Numeracy is the ability to understand numerical information about risks and probabilities and has been associated with several decision making biases. Low numeracy limits risk understanding and biases risk perception, and may thus have negative effects on important decisions about health. One such decision is when to seek medical attention for heart attack symptoms. Survival rates improve dramatically if treatment is administered within one hour from symptom onset, yet many individuals delay seeking help. In a retrospective study, we investigated the relationship between numeracy and delay in seeking medical attention for acute coronary syndrome. Using standardized tests, we measured numeracy in 108 patients (mean age=58, 32-74) about five days after the cardiac event. We conducted multiple regression analyses controlling for demographics, education, cardiovascular history, doctor visits, perceived severity of symptoms, disease severity, mental state, and days elapsed from the cardiac event. Numeracy was significantly associated with shorter delay times. Fifty-seven percent of patients with low numeracy waited more than an hour, while only 35% of patients with high numeracy waited more than an hour. These findings illustrate the potential beneficial effects of numerical, probabilistic thinking for high-stakes decision making. Potential mechanisms are better recall of risks and calibrated risk perception.

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### **Visualization of the Cognitive Dimensions for Evaluating Universities By Means of the Content Analysis of Evaluation Reports.**

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Background; It has been pointed out that the credit hour system in Japanese higher education has not functioned as well as it was originally intended. To tackle this issue, this study focused attention on the cognitive process of evaluator's judgment for the universities

by extracting words in their peer-reviewed evaluation reports, and attempted to clarify the indicators for measuring the effectiveness of credit hour system. Material and methods; Morphological analysis was applied to extract words from evaluation reports titled "Certified Evaluation and Accreditation" in the first (2005-2011) and second (2012-2014) cycles targeting 186 universities. Accreditation standard 5 (key area: 5-1-3 "consideration for substantialization of credit hours") was selected. Keywords or expressions which were frequently referred by the evaluators were sorted by category, and their number was counted. Results and Conclusions; Results showed 13 indicators were used to evaluate the effectiveness of credit hour system. Correspondence analysis was performed on the data of the cross table which consists of indicators, categories of annual changes (the first and second cycles), and the difference by program (graduate and undergraduate). Factor1 was contributed by the characteristics named "survey on student study hours" and "facilities". "GPA system" and "the CAP system" were accounted for by Factor2. These dimensions revealed the cognitive structure of evaluators, and suggested useful indicators.

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### The Role of Motor Activity in the Solution of Insight Problems.

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One of the crucial difficulties for nowadays psychology of problem solving is understanding of insight problem solving. At this moment there are two leading theories in this field: the criterion for satisfactory progress theory (MacGregor et al., 2001) and the representational change theory (Ohlsson, 1992). The former explains the solution process appealing to top-down processes, particularly to application of heuristics which solver uses to select his steps during solving process (MacGregor et al., 2001). The latter emphasizes the bottom-up processes, which constrain the search space that results in necessity of restructuring of the initial representation of a problem for successful solution (Öllinger et al., 2014).

At the same time recent researches contain strong evidence of important contribution of sensory-motor systems to higher mental processes (Barsalou, 1999; Pulvermüller, 2005). Furthermore, researches of interaction between perceptual processes and action planning allow maintaining a common format for motor and perceptual representations (Hommel et al., 2001). All of this leads to an assumption that motor activities and bottom-up perceptual processes connected to them play highly important role in insight problem solving when a sequence of movements is crucial (for example, the nine-dot problem (Maier, 1930)).

In a series of experiments using the nine-dot problem was obtained the evidence that short preliminary motor training (on another material) of drawing the lines which are part of the correct solution, significantly decreases amount of time needed for the solving of this problem. The result demonstrates the importance of motor activity for solving this kind of insight problems.

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### Judgments of Trustworthiness are Independent of Viewing Angle.

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Trustworthiness judgments are highly efficient and occur in as little as 100 ms (Willis & Todorov, 2006). However, research so far has focused almost exclusively on trustworthiness judgments obtained for full frontal views of faces. In real life we are often presented with side views, i.e., partially obscured, faces but we still make judgments about them. In this experiment we studied trustworthiness judgments from five different facial views to identify possible loss of trustworthiness information due to the obstruction of parts of the face when the face is presented in a side view. A sample of 162 adults (128 female) rated on 7-point Likert scales the trustworthiness of 24 (12 female) neutral expression photographs from the Radboud Faces Database (Langner et al, 2010). The target faces were presented in full frontal, left semi-profile, right semi-profile, left profile, or right profile view in a between-subject design. The trustworthiness ratings between the five viewing conditions were highly correlated, suggesting viewing angle independence for the assessment of trustworthiness. We argue that, due to its evolutionary significance, trustworthiness information can be extracted equally well from full frontal and partially obscured facial views. A follow-up experiment is under way to compare the effects of viewing angle on judgments of trustworthiness with the effects of viewing angle on judgment of less socially and evolutionary significant traits.

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### Domain-Specific Cognition

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### Examining the Roles of Fluency, Working Memory, and Pressure in Math Anxiety and Math Performance.

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Math anxiety is a pervasive problem that negatively impacts math performance and attitudes. Math anxiety ties up working memory capacity, thereby disrupting cognitive resources necessary for math performance (Beilock, 2008). This study investigated the previously unstudied influence of fluency on math performance, math anxiety, and working memory. Fluency is defined as the ease by which items are cognitively processed (Oppenheimer, 2008). We used easy (single-digit) and difficult (double-digit) modular arithmetic problems, classified as either fluent [e.g.,  $44 = 22 \pmod{2}$ ] or disfluent [e.g.,  $26 = 11 \pmod{3}$ ], based on how random the numbers were, to examine how actual problem difficulty would interact with problem fluency. In accordance with methods employed by Beilock, we examined problem solving performance in both high and low pressure conditions to see how problem type (i.e., problem difficulty and fluency) interacts with participants' math anxiety and working memory span to affect performance. We collected ease of solving judgments before participants attempted to solve math problems. Fluency and difficulty influenced these judgments, indicating participants can attend to both factors. Problem solving was affected by a combination of all factors, suggesting fluency played a role in math performance, even for those under pressure. Fluency may be a promising factor that reduces anxiety while



increasing performance, possibly creating an immunizing effect.  
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### Motivated Attention and Evaluative Ratings across the Life Span: Emotional Arousal and Gender.

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This study was designed to investigate the evolution of emotional picture processing over the adult life span as a function of stimulus arousal and participants' gender. Motivated attentional capture, here revealed through a behavioral interference paradigm, together with affective ratings were measured in a large sample of participants (n=211) balanced by gender and equally spread across the seven decades from 20 to 90 years. Results showed that, overall, participants showed the typical reaction time (RT) slowdown to target detection after viewing a high-arousing emotional (either pleasant or unpleasant) picture, compared to when the picture depicted a neutral content. Low-arousing unpleasant pictures were also effective in prompting a slight but significant RT slowdown relative to neutral and low-arousing pleasant pictures. Interestingly, this RT affective modulation was similar across participants, regardless of age and gender. Age-related effects were much more evident on the evaluative ratings of these same pictures, especially for those depicting pleasant contents: as age increased, low-arousing pleasant cues (e.g. images of babies) were evaluated as more pleasant and arousing by both males and females, whereas high-arousing stimuli (e.g. erotic images) were experienced as less pleasant only by older females. On the other hand, subjective ratings of unpleasant pictures, with either high or low arousal contents, did not show relevant changes across the lifespan. Taken together, these findings suggest that specific emotional cues prompt different subjective responses across age groups, while basic mechanisms involved in attentional engagement towards both pleasant and unpleasant stimuli are preserved in healthy aging.

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### Aging and Episodic Memory: The Role of Executive Functioning and Processing Speed According To the Strategic Support at Encoding.

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The aims of this study were to increase knowledge about the involvement of executive functions and processing speed in episodic memory functioning and to better understand their contribution as potential mediators of age-related differences in episodic memory when the level of strategic support at encoding varied. In the condition without strategic support, 19 younger and 20 older adults were simply instructed to study the word pairs. In the condition with low strategic support, 21 younger and 20 older adults were provided encoding strategies without information about their effectiveness. In the condition with high strategic support, 19 younger and 19 older adults were given encoding strategies and instructed about their effectiveness. All participants were also administered neuropsychological tests (executive functions and processing speed). Firstly, results showed that the more the strategic support was high (helpful) the more the age-related differences on

memory performance decreased. Secondly, the factors accounting for the age-related differences in memory performance were different according to the level of strategic support. Without strategic support, processing speed was the only mediator of the age effects on memory, then with low strategic support it was executive functions and finally, with high strategic support it was age. These findings were interpreted according to the processing-speed theory (Salthouse, 1996), the executive decline hypothesis (West, 1996), the environmental support hypothesis (Craik, 1983, 1986), the compensation-related utilization of neural circuits hypothesis (Reuter-Lorenz & Lustig, 2005).

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### Conceptual and Physical Magnitudes in Dyscalculia and Dyslexia.

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Introduction: Magnitude is a multi-dimensional concept that includes conceptual magnitudes (i.e., the internal representation of an object's size) and physical magnitudes (i.e., the perceived size of an object). Recently, we found that both physical and conceptual magnitudes are processed automatically. This study examined automatic processing of conceptual magnitude in developmental dyscalculia (DC) and developmental dyslexia (DL). Previous studies found that those with DC, but not DL, have weaker automaticity of number processing. However, it is not known how they process conceptual magnitude.

Method: Conceptual and physical magnitudes were manipulated orthogonally to create congruent (e.g., a physically small apple compared to a physically large violin) and incongruent (e.g., a physically large apple compared to a physically small violin) conditions. The difference in reaction times between incongruent and congruent trials (i.e., congruity effect) is considered to be a measure for automatic processing of the irrelevant dimension. Participants were instructed, before each trial, to respond to the larger object on the screen (physical comparison) or in real life (conceptual comparison).

Results: In the conceptual comparison (when physical magnitude was irrelevant), all participants responded in a similar manner and presented a congruity effect. In contrast, in the physical comparison (when conceptual magnitude was irrelevant), control and DL subjects presented a congruity effect, however DC subjects did not, suggesting lack of automaticity of conceptual magnitude.

Conclusions: Our results fit with previous findings of weaker magnitude representation in dyscalculic subjects and support theories of a shared neurocognitive substrate for different types of magnitude.

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### Older Adults Rely More on Executive Control in Fluid Reasoning Than Young Adults.

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Objectives/Introduction. While evidence supports the view that executive functions, which depend mainly on the prefrontal cortex, are among the main cognitive functions to show age-related decline, paradoxically, recent neuroimaging studies have observed



age-related PFC overactivations, and behavioral studies have suggested that there is a greater relationship between executive functioning and certain cognitive functions (in particular episodic memory) in older than in young adults. The main aim of the present study was to examine the hypothesis of an increase with aging in the reliance on executive controlled processes. To achieve this we examined whether representation (knowledge) and executive control are differentially involved in young and older adults when performing fluid reasoning tasks. Methods. Young and older adults were administered the Culture Fair Intelligence Test to assess fluid reasoning and crystallized knowledge and executive function measures to assess representation and control. Results. Results replicated the classic age-related decrease in fluid reasoning and control processes, and preservation of knowledge representations. Factor analysis confirmed the independence of the two components and the results showed that the correlation between reasoning and control was significantly greater in older than in young adults. These results were also observed in a selected group of executive young-like older adults and were confirmed through a GLM analysis revealing a significant interaction of age with the control. Conclusion/Discussion. These results confirm the greater reliance on executive control in older adults which may correspond to an active mechanism to cope with age-related difficulties.

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### Electrophysiological Markers of Executive Functions and Math Competence in Preschool Children.

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Cognitive flexibility, working memory and inhibitory control are known as the Executive Functions (EFs) that support higher-level cognitive processes such as planning, problem solving, and reasoning. Evidence in the field shows that EFs play a central role in the acquisition of academic skills and mathematics ability. Event-related potentials (ERPs) studies show that during late childhood, the amplitude of the ERPs components associated to the resolution of conflict when children perform a flanker task, is a significant predictor of math grades. This study aims to understand the neural basis of the development of EFs and its relation to preschoolers' mathematical competence. 45 children aged between 5 and 6 years performed a battery of tasks that assesses the three main domains of EFs (flanker, stroop, Go-NoGo and working memory span) while high-density EEG was being recorded. Children's intelligence and mathematical competence were also measured using the WPPSI-III and the TEM-3 test, respectively. Results show that EFs are highly correlated with children's intelligence and mathematical competence. Multiple regression analysis showed that among the EFs, shifting is the strongest predictor of mathematical competence. Finally, ERPs analysis showed a correlation between the latency of the N2 component associated with the resolution of conflict and children's performance on the mathematics ability test. These findings confirm the association between executive functions and the development of mathematical ability, and highlight the role of cognitive flexibility and attentional control for this association.

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### Age Differences in Decisions about Gains and Losses.

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In many situations, valuations of options require to weigh potential gains and losses against each other. Moreover, this information is often not available in the environment but needs to be retrieved from memory. In the present line of research, we examine age-related differences in rapid decision making with a paradigm that involves these two aspects (i.e., integration and retrieval of values) from a lifespan perspective. In an initial training phase, participants learn a mapping between perceptual stimulus features and associated values (positive vs. negative; magnitude of the outcomes). In a subsequent decision phase, participants are shown objects that represent combinations of these features and are instructed to decide as quickly as possible whether to accept or reject these objects, depending on their net value. We use a diffusion model to disentangle the decision components underlying rapid gain-loss evaluation. Compared with older adults, the modeling results for younger adults as well as school-age children indicate higher speed of information uptake and shorter peripheral nondecision time. Overall, these findings contrast with the perceptual decision-making literature, where age differences mainly emerge in response cautiousness (more cautious speed-accuracy settings in the elderly) and nondecision time. We discuss the role of strategic and associative memory components as well as numeric abilities that can explain these age effects.

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### Effects of a Sanitary Mask on Perceived Facial Size and Attractiveness.

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Facial accessories, such as glasses, have been shown to affect facial appearance in terms of physical attractiveness. Currently, some Japanese women use a sanitary mask as a beauty item on the basis of a popular belief that use of a mask reduces the perceived size of the face and results in a 'better' head-to-body ratio. The purpose of the present study was to examine the effects of wearing a sanitary mask on the perceived size of the face. In total, 66 female face images were pre-rated and grouped into three facial size categories (small, medium, and large). An image of a sanitary mask was superimposed digitally on the original face images. Participants rated the perceived facial size of a face image on a 1-100 visual analog scale, with 50 as the average size and larger (smaller) numbers for larger (smaller) sizes. The original face images were also rated for comparison. Another set of participants rated perceived attractiveness. The results indicated that perceived facial size was decreased by wearing a sanitary mask. The presence/absence of the mask interacted with the size of the original faces, indicating that the illusory size reducing effect of the mask was stronger for larger faces. Wearing a mask decreased physical attractiveness generally. These results suggest that wearing a mask can reduce perceived facial size but does not contribute to improving attractiveness.

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### The Way of Solving Arithmetic Problems When You Listen To Simple Additions.

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In two experiments, we evaluated the role of the auditory-verbal format in the co-activation and the selection by inhibition of simple arithmetic facts. Participants performed a verification task composed by blocks of two consecutive trials. Simple additions were presented and they had to decide if the answer was correct or not. In Experiment 1 additions were presented in the auditory-verbal format, in Experiment 2 additions were presented visually but in a sequence that simulated the timing of auditory problems. Results were similar in both formats. In the first trial, participants took the same time to respond when the result of an incorrect addition was that of multiplying the operands (e.g.,  $2 + 4 = 8$ ) compared to a control addition (e.g.,  $2 + 4 = 10$ ). In the second trial, participants took more time to respond when the result of multiplying the operands was presented again in a correct addition (e.g.,  $2 + 6 = 8$ ) relative to a control addition (e.g.,  $4 + 6 = 10$ ). In the first trial, the results are contrary to the confusion effect reported in previous research. They are discussed in terms of sequential effects in the resolution of arithmetic problems. The results of the second trial suggest that the related multiplication answer in the previous trial (e.g., 8) was inhibited to select the correct response (e.g., 6). Email: Patricia Megías García, [patriciamgarcia31@gmail.com](mailto:patriciamgarcia31@gmail.com)

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### Do Children always Need Their Fingers to Succeed in Mathematics?

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In children, performance on a finger gnosis test, which measures finger sensitivity, is a better predictor of mathematical abilities than classical tests measuring intelligence. Two different explanations can account for this surprising result. First, this relationship between fingers and numbers can be explained by a mere coincidental neuroanatomical overlap of the brain areas devoted to finger representation and numerical processing. Second, this relationship could stem from a real functional link between fingers and numbers. Higher finger sensitivity could facilitate finger counting because each finger pattern could be neatly associated with a numerical pattern and, in turn, good finger counting abilities could boost mathematical learning. In this study, we examined these two hypotheses by assessing non-symbolic and symbolic numerical competencies in children suffering from cerebral palsy and presenting finger motor impairments. Within the neuroanatomical hypothesis, both symbolic and non-symbolic numerical abilities should be impaired in children with cerebral palsy. However, within the functional hypothesis, only symbolic abilities, which emerge after counting on fingers, should be damaged. Our results show that some early non-symbolic numerical skills are preserved in children with cerebral palsy. This suggests an independent recruitment of the neuronal areas dedicated to fingers and quantities. Moreover, difficulties in counting are associated with low dexterity, which supports the functional hypothesis. Nevertheless, performance in pure symbolic numerical tasks is similar in children with cerebral

palsy and normal-developing children. This result shows that it is possible to succeed in mathematics without efficient finger use and compensation strategies or mechanisms might explain this phenomenon.

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### Anxious Attention: Math Anxiety Predicts Amygdala Reactivity to Mathematical Stimuli.

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Math anxiety has been characterized by underperformance in mathematics, ultimately resulting in avoidance of math classes, and steering away from careers that rely on mathematical skills (Ashcraft, 2002). Anxious emotion in math anxious (MA) individuals may cause similar cognitive and neural changes to those seen in general anxiety. Anxious individuals show increased engagement to negative information, have difficulty disengaging from this information even when irrelevant to the task at hand, and show an increased amygdala response to negative stimuli (Bishop, 2004; 2008; Mogg, et al., 1995; Saleminck, et al., 2007). This engagement bias, as well as the amygdala response, indicates that anxious emotion increases exogenous attentional orienting towards negative stimuli and increased fearful reactivity. The present study investigated whether math anxiety is associated with a similar lowlevel

anxious response that is specific to math stimuli. Participants (N=40) completed a dot probe attention task during fMRI scanning. This task compared attentional deployment following exposure to a) negative pictures versus neutral pictures, and b) mathematical symbols versus unfamiliar letters. Increased activity in the right amygdala during exposure to math symbols (Math > Letters) was significantly correlated with math anxiety ( $r=0.14$ ,  $p=0.01$ ). As self-reported math anxiety increases, amygdala reactivity to math stimuli also increases. These results indicate that even brief exposure to math symbols triggers fear-related activity in the brains of MA individuals. Although participants were not performing math operations in this task, exposure to math symbols was associated with neural activity related to increased vigilance and fearful affect. Email: [Rachel.g.pizzie.gr@dartmouth.edu](mailto:Rachel.g.pizzie.gr@dartmouth.edu)

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### Replication of the Neuronorma Scale in Elderly Population.

RAQUEL RODRÍGUEZ FERNÁNDEZ, SARA GARCÍA HERRANZ, CARMEN DÍAZ MARDOMINGO, CÉSAR VENERO NÚÑEZ, HERMINIA PERAITA ADRADOS, *UNED*. Neuronorma Project (Peña-Casanova et al., 2007) is a normative study of series of neuropsychological tests in older Spanish sample, correcting age and education effects, following the methodological aspects at Mayo Clinic (Mayo's Older African Americans Normative Studies). Our goal is to replicate this normative study for the following tests: Semantic Fluency (animals); Phonetic Fluency (words beginning with P); TMT-A and TMT-B; and, Rey-Osterrieth Complex Figure (time of copy and quality), in a sample of 358 older adults, cognitively normal and without previous history of neurological alteration or symptoms of depression. We found statistically significant differences between our norms and Neuronorma in this tests: Semantic Fluency, Phonetic Fluency,

TMT-A (after correction for education the differences disappear), TMT-B and in the copy of Rey-Osterrieth Complex Figure (in execution time and quality). In general, our norms transform the direct punctuations in a lower scaled score than Neuronorma does. Several factors may account for the discrepancy between norms obtained in Neuronorma and our present study: Neuronorma's sample population includes bilingual participants (Catalans, Galicians and Basques), while our sample is Spanish monolingual; the average age is lower in Neuronorma ( $M = 64.9$ ,  $SD = 9.3$ ) than in our sample ( $M = 69.1$ ,  $SD = 5.9$ ); average years of education in Neuronorma's sample is also lower ( $M = 10.4$ ,  $SD = 5.4$ ) than in our sample ( $M = 12.1$ ,  $SD = 6.2$ ). We consider that comparison of different normative studies is useful to have a reliable vision of cognitive performance in the elderly.

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### Predicting Performance in Single-Digit Multiplications: The Role of Cognitive and Emotional Variables.

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The mastering of single-digit multiplications is a challenge for a big amount of children. Recent research have suggested that some basic numerical skills, like those measured in Arabic comparison tasks, i.e. the access to numerical representations from symbols, are good predictors of children's performance in single digit multiplication. On the other hand, emotional variables like maths anxiety play a role in the learning of arithmetical facts. The aim of the current research is to study the role of several basic numerical cognitive skills together with emotional factors in single-digit multiplication solving in a longitudinal study. Math anxiety, trait anxiety, non-symbolic numerical comparison, Arabic comparison and subtraction fluency were assessed in first, second and third-grade Spanish children, ( $N=141$ , male=66, female=75, ages 6 – 9). Three years later multiplication fluency was assessed. The results showed that performance in multiplication was significantly predicted by performance in Arabic comparison and subtraction tasks, supporting previous results. More importantly, participant's score in trait anxiety, but not math anxiety, arose also as a significant predictor. Results point out the role of both cognitive and emotional variables in predicting children performance in single-digit multiplications. Email: Juan Antonio Álvarez-Montesinos, [juan.alvarez.uma@gmail.com](mailto:juan.alvarez.uma@gmail.com)

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### How Motivational Intensity Affects False Memory.

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Regarding the motivational dimension model of affect proposed that both positive and negative affect varies in the degree with which it is associated with approach motivation. Some positive affective states are relatively low in approach motivation, whereas others are relatively high in approach motivation. This study's aim was to understand motivational intensity effects on false memory. Amusement (low motivational intensity) and desire (high motivational intensity) affective states used in the study. Both affective state are positive and high in arousal but they differentiate into motivational intensity. Low and high approach-motivated positive affects were manipulated with short video clips in study. Study was conducted as between subject design and 60

psychology students participated. Ten DRM lists were presented visually and each list consisted of ten associative words. Memory was tested by six points confidence scale for old/new recognition. Signal detection measures used for calculate sensitivity and bias values. Sensitivity estimates were higher for participants in the high approach motivational intensity condition than for participants in the low approach motivational intensity condition and control condition. This suggests that higher intensity levels of approach motivation enhanced item-specific memory and therefore improved participants' ability to distinguish between actually studied words and related lure words. When comparing critical targets to list targets as well as critical distractors, high approach motivational intensity participants responded more liberally than low approach motivational intensity participants and control participants did. These results indicate that different motivational intensity levels have different effects on memory and should be considered in future studies.

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### Language Processes

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### Parafoveal Preview Effects from Word N+2 During Reading: A Bayesian Meta-analysis.

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#### Background

Do readers obtain information from the second word to the right of the current fixation (word n+2)? This is a question of great theoretical interest, but currently no consensus exists due to the mixed findings in the literature. The present study addressed this issue by doing a Bayesian meta-analysis of word n+2 studies. Bayesian inference is especially suitable to answer this question because it provides estimates that are conditional on the available data.

#### Material and Methods

Eleven published experiments were analyzed in a Bayesian random-effects meta-analysis. Using a range of prior distributions, estimates for the effect size measured with first fixation duration (FFD) and gaze duration (GD) were computed. The preferred prior distribution was  $\mu \sim \text{Unif}(-30, 30)$ , which assumes equal probability of  $\mu$  on this interval.

#### Results and Conclusions

There was 95% probability that the effect of previewing word n+2 lies between 2.25 and 7.48 ms for FFD (Mean=4.87), and between 1.32 and 13.7 ms for GD (Mean=7.5). The probability that the two effects are smaller than 1 ms was 0.004 and 0.02, respectively. Interestingly, comparable preview effects were also observed on word n+1. A separate analysis with alphabetical-only studies revealed similar, but slightly smaller and less certain estimates. Although the effect sizes were relatively small, the weight of the evidence leaves little doubt that readers do obtain some information from word n+2. It is argued that future research should focus not on the existence of n+2 preview effects, but on their theoretical meaning.

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### Language Knowledge and Context Affect How Comprehension Spills Over To Production.

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Language contexts vary dramatically around the world, leading to diverse linguistic experiences for monolinguals, language learners, and proficient bilinguals. While only bilingual speakers experience the effects of switching between a second language (L2) and the native language (L1), all speakers, including monolinguals, encounter situations in which an L2 (known or unknown) is heard and semantically supported by context through gestures, the surrounding environment, or translation. The present study examined how comprehension in the L2 (in bilinguals) or the intention to comprehend the L2 (in monolinguals) affects the ability to subsequently speak in another language. Participants performed a picture-naming task while event-related potentials (ERPs) were recorded. They named pictures from the first block in one language, viewed pictures while listening to the names in another language during the second block, and returned to the first language for naming the pictures in the third block. Participants varied in language knowledge as well as context: Mandarin-English bilinguals in the USA, monolingual English participants in the USA, Cantonese-English simultaneous bilinguals in Hong Kong, and monolingual English participants in Hong Kong. Initial ERP analyses reveal a modulating effect of language experience, such that bilinguals benefit from repetitions of both heard and spoken items, monolinguals in the USA who listened to pictures named in an unknown language are not facilitated in subsequent naming, and monolinguals living in Hong Kong experience interference for naming items that were previously heard in Cantonese. These results suggest that language experience and language context change how comprehension affects production.

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### On the French Listeners' Ability to Use Stress during Spoken Word Recognition.

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Previous studies have suggested that French listeners can experience difficulties when they have to process stress at an abstract level of processing (Dupoux et al. 1997, 2001, 2010; Peperkamp et al. 2010). A potential limitation of these studies is that they used stress patterns that do not respect the rules of stress placement in French. In this study, we tested three stress patterns on bisyllabic French words: jury vs. *jury*' (unstressed vs. 2<sup>nd</sup> syllable with primary stress), *ju*'ry vs. *jury*' (1<sup>st</sup> syllable with primary stress vs. 2<sup>nd</sup> syllable with primary stress) and jury vs. *ju*'ry (unstressed vs. 1<sup>st</sup> syllable with primary stress). In an ABX task, participants heard three items produced by three different speakers and have to indicate whether X was identical to A or B. The stimuli A and B varied (i) in their stress pattern (*jury*', jury, *jury*'), (ii) in their last phoneme (*jury*', *juron*', *jury*') or (iii) in both their stress pattern and their last phoneme (*jury*', *juron*', *jury*'). The results show that French listeners are fully capable to discriminate between

words differing in stress patterns provided that either A or B was unstressed. Implications of these findings will be discussed in light of current models of spoken word recognition.

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### Non-target Language Phonological Rule Activation in Bilinguals.

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Auditory input activates bilinguals' two languages simultaneously (e.g., Marian & Spivey, 2003) and bilinguals may use domain-general cognitive control mechanisms to overcome this type of linguistic competition (Blumenfeld & Marian, 2013). The present study examined whether bilinguals accessed non-target language phonological rules, or rules for combining speech sounds, during comprehension (e.g., the addition of a vowel to Spanish s+ consonant onsets, *spiral/espíral*) and whether they relied on cognitive control mechanisms to overcome non-target language phonological rule activation. *Materials and Method.* In an English cross-modal lexical decision task, participants heard primes (cognates, non-cognates) containing s+ consonant onsets or controls without s+ onsets, followed by a lexical decision on visual targets with the /e/ phonological rule or controls without /e/. If primes (*spiral*) activated Spanish phonological rules, then faster responses to non-words with phonological form and phonological rule overlap (*exploded*) and phonological rule overlap only (*edabling*) were predicted. Participants also performed the non-linguistic Stroop arrows task (from Blumenfeld & Marian, 2013). *Results.* Spanish-English bilinguals, not English monolinguals, responded faster to the phonological form+phonological rule condition preceded by cognates than to controls preceded by cognates. Bilinguals also responded faster to phonological form+phonological rule and phonological rule only conditions preceded by non-cognates than to controls preceded by non-cognates. Correlations between the Stroop effect and the phonological rule competition effect were observed only in bilinguals. *Conclusions.* These findings demonstrate that bilinguals access Spanish phonological rules during English-only comprehension and employ domain-general cognitive control mechanisms to manage competition.

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### Exploring the Effects of Emotionality on Ambiguous Relative Clause Attachment.

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When processing Spanish ambiguous relative clauses (RC) modifying a complex NP (CNP; e.g., someone shot the *servant* [NP1] of the *actress* [NP2] who... [RC]), Spanish speakers have a preference for attaching the RC to NP1. Recently, Grillo & Costa (2014) identified a confounding factor in the literature on RC attachment. They hypothesized that once this confounding factor is excluded, genuine RCs are initially attached to NP2. On the other hand, Fraga et al. (2012) found in sentence completion studies that



emotional words tend to drag the attachment preference towards NP1 or NP2 depending on where the emotional word appears. So far, there are no data about an emotionality effect on attachment preferences when using online reading tasks. The present eye-tracking study aims to fill this gap, by excluding the confounding factor identified by Grillo & Costa (i.e., the use of perceptual verbs). Twenty quartets of Spanish ambiguous RC sentences were built by crossing the factors attachment site (NP1 vs. NP2) and emotionality of NP1 (Neutral vs Emotional). Gender agreement was used as the disambiguating information. Sentences such as the following (adapted to English) were used: —The boy called the *assistant* of the *seller* who (he/she) was sitting behind the counter. —The boy called the *girlfriend* of the *seller* who (he/she) was sitting behind the counter. The results show that in the neutral condition participants initially attach the RC to NP2. In the emotional condition this preference is reduced, showing that emotionality has a modulatory effect on RC attachment preferences.

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### Associative vs. Error-Driven Accounts of Learning in Word-Meaning Priming.

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Rodd et al. (2013) demonstrated a word-meaning priming effect such that a single presentation of an ambiguous word (e.g. bark) in a sentence resolved to the subordinate meaning can change the later interpretation of the same word presented without context. The present studies investigated the nature of the learning mechanism that underlies this priming effect. An associative learning account predicts greater priming when the disambiguating context is provided *before* the ambiguous word (early disambiguation), which ensures that the appropriate (subordinate) semantic information is available to the listener at the time when the ambiguous word is processed. By contrast, an error-driven account predicts greater priming when the critical context is given *after* the word (late disambiguation), due to the mismatch that results from initially retrieving the inappropriate dominant meaning. In Experiment 1, adult participants listened to early- and late-disambiguation sentences while making judgements about their semantic relatedness to probe words. After a delay of about 20 minutes, participants were tested on their meaning preferences for primed and unprimed ambiguous words using word association. The results showed significantly greater priming for words in early- compared to late-disambiguation sentences. Experiment 2 showed that recognition memory for the priming sentences does not differ between early- and late-disambiguation conditions, suggesting that the Experiment 1 result is not driven by a difference in explicit recall between the two conditions. The results are consistent with an associative learning account whereby the co-activation of the subordinate meaning and ambiguous word underpins the retuning of lexical-semantic representations.

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### What about the Syntax? Bilingual Word Recognition in Sentence Context.

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Bilinguals co-activate lexical and syntactic alternatives in both languages when reading or speaking in one language. We report two experiments on L1 Spanish – L2 English bilinguals to determine whether language-specific syntactic information modulates lexical co-activation. In Experiment 1, bilinguals named targets that provide reliable indices of co-activation (cognates and homographs) that were embedded in Spanish sentences containing actives, passives, and prepositional object structures (POS). Actives and passives share word-order and exhibit cross- language syntactic priming (CLSP; a measure of syntactic co-activation) between Spanish and English, suggesting that they are language non-specific structures. POS optionally differ in word- order across English and Spanish and can be considered language-specific, but the propensity for CLSP has not been tested in Spanish and English. If language-specific structures provide a means to attenuate the unintended language, cross-language effects should be eliminated within POS compared to actives and passives. In Experiment 2, bilinguals completed a CLSP task. If actives and passives are language non-specific, there should be significant priming. If POS are represented in a language-specific manner, then they should not exhibit priming between English and Spanish.

Data from Experiment 1 showed evidence of parallel activation of the L2 during L1 reading. The cross-language effects were modulated by the type of syntactic structure, indicating that syntactic information impacts cross-language co-activation: dative structures reduced cognate facilitation and reversed the sign of the homograph effect. Data from Experiment 2 revealed cross-language priming for active and passive structures but not for datives, suggesting that dative structures may be language specific.

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### Words We Do Not Say – Context Effects on the Activation of Lexical Alternatives in Speech Production.

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Although there is compelling evidence that the context of an utterance strongly influences the choice of words we actually produce (e.g., whether we refer to a particular animal with the word “dog” or “poodle”), little is known about whether the context already affects the degree to which the different alternatives are lexically activated. Using a picture-naming task, we explored the effect of a preceding linguistic context on the phonological activation of name alternatives. Pictures were either preceded by a neutral request (“name the object!”) or a constraining request (“name the dog!”). With a neutral context both the specific picture name (“poodle”) and the basic-level picture name (“dog”) are adequate responses. With a constraining context, by contrast, the basic-level name is a locally inadequate response. While participants named the





pictures with their specific names (e.g. “poodle”), the phonological activation of the basic-level picture name was assessed by using auditory distractor words phonologically related vs. unrelated to that name (e.g., “doll” vs. “book”). Regardless of the type of context, phonologically related distractors interfered with the naming response compared to unrelated distractors. This finding suggests that a preceding linguistic context cannot prevent that name alternatives are phonologically activated and compete for selection, even when they are no adequate response candidates in the given situation.

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### **Relationships among Individual Differences in Speech Perception, Speech Production and Cognitive Abilities: A Case Study of Cantonese Tone Merger.**

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Studies of speech processing have generally made the implicit assumption that speakers can distinguish all sounds of their mother tongue in perception and production. However, sociolinguists have long recognized that native speakers vary in their ability to discriminate speech sounds in their language. It has been suggested that such individual differences are related to variations in cognitive functions (Ohala, 1981; Yu, 2010; Law, Fung, & Kung, 2013; Ou & Law, 2015). The present study systematically investigates the relationships among individual differences in speech perception, speech production and cognitive abilities in a tone merging phenomenon in Cantonese, where speakers may differentiate the two rising tones (high and low rising) in both perception and production [+Per+Pro], only in perception [+Per-Pro], or in neither modalities [-Per-Pro]. Behavioral and neural measures of perception include discrimination  $d'$  and components of event-related potential – the mismatch negativity, P3a, and rise time of amplitude envelope. Acoustic measures of pitch offset difference and rise time difference reflect distinctiveness in production. Components of attention and working memory in auditory and visual modalities are assessed with published cognitive test batteries. The results show that both pitch contour/height and rise time contribute to distinctive perception and production of rising tones, measures of perception (behavioral and neural) and production are correlated with each other, and attentional shifting in visual and auditory modalities significantly predict performances of discrimination and production. The overall findings suggest that attentional switching influences the quality of phonological representations, resulting in different degrees of distinctiveness in perception and production.

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### **Morphological and Semantic Effects in the Production of German Compound Nouns.**

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Our study examines how compounds are stored and processed at different levels in the production lexicon (lemma vs. word-form). With the picture-word interference paradigm, written distractor words were superimposed onto pictures that had to be named with compound words. Effects of distractor words on compound naming

were examined with behavioral (accuracies and latencies) and electrophysiological measures (ERPs). In four related distractor conditions (each with a matched unrelated distractor), distractor words overlapped with the target in the first or second constituent (lip or stick for the target lipstick), were semantic-categorically related either to the compound target (powder → lipstick), or to the first constituent of the target (toe → lipstick). We predicted facilitation for both morphological conditions, and interference for the target-related categorical condition. If compound naming involves access to multiple lemmas (e.g., lip and stick for lipstick), we also expected interference in the constituent-related semantic condition. The behavioral data confirmed morphological facilitation for both constituents of compound targets, and semantic interference for target-related distractors. However, no effects were obtained for constituent-related distractors. Thus, the behavioral data corroborate a single-lemma, but multiple morpheme representation of compounds in the German mental lexicon. The EEG data complement the behavioral findings.

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### **A Normative Study for Photographs of Celebrities in Spain.**

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Celebrities (i.e., their faces, proper names, or occupations) are recurrently employed in many psychological domains interested in the processing of familiar people (psycholinguistics, memory, attention, face processing, developmental studies, etc.). These materials, that need to be highly controlled for experimental purposes, can be very constrained by the geographic context where the studied sample resides. However, despite its relevance in psychological research, there is no normative study for famous people in Spain. The most frequently produced famous people from 24 occupational categories were selected for a normative study in a young adult Spanish sample. The photograph, the most frequently produced proper name, and several subjective (distinctiveness, age of acquisition, proper name and face agreement, subjective frequency, and naming times) and objective (number of phonemes) indices were obtained for each celebrity. These norms are likely to make a useful contribution to the design of more controlled research and applied tools in Psychology.

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### **Model Selection across Multiple Segmentation Schemas Reveals Mandarin Chinese Phonological Neighborhood Effects.**

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The role of lexical tone in the mental lexicon is little understood. A challenge to understanding the role of tone, is identifying the phonological units within a tonal syllable. Mandarin is accordingly a tonal language that offers numerous proposals as to syllable segmentation schemas. We address this problem through what is known about lexical competition, namely that phonologically similar words, also known as neighbors, compete for selection during

retrieval. Two metrics used across multiple non-tonal languages to measure the influence of phonological similarity are phonological neighborhood density (PND) and frequency weighted neighborhood density (FWD). Using a subtitle corpus we constructed lexicons differing according to 14 segmentation schemas. Calculations for PND and FWD were made for each lexicon. The goal of the current study was to assess which of the lexicons, 7 schemas with tone, and 7 without tone, best fit speech production according to an auditory shadowing task. We performed model selection using mixed effects modelling and found that the schema best fit for PND (CV\_V\_X\_T) differed only in tone to the schema best fit for FWD (CV\_V\_X), while frequency explained a greater portion of the variance. Both models mirror the direction found in English, wherein the greater the number of similar sounding words a target word has, the slower its production. The current study presents a novel method in the discussion of Mandarin syllable segmentation, and tentatively leads to an understanding of the Mandarin mental lexicon as organized according to lexical tone.

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### Lexical Access in Bilinguals: Cognate Processing During Visual Word Recognition.

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One of the main aims of psycholinguistics is to better understand the organization of the mental lexicon. Cognate processing has long been used to explore bilingual's mental lexicon organization, cognates can be thought of as supra-lexical morphological representations that are modality and language independent. In the present study, 25 Spanish-English bilinguals (with different levels of proficiency) and 25 English monolinguals performed a lexical decision task while Event Related Potentials (ERP's) were recorded. The stimuli consisted of 300 English-Spanish identical cognates (e.g. IDEA), 300 English only words (e.g. KEYS), and 600 pseudo-words. In order to explore possible cumulative frequency effects effect (sum of the cognate frequencies across languages), the surface frequency range of the cognates was manipulated. The behavioral and response data showed different patterns for the bilinguals (when compared to monolinguals), where a cognate processing facilitation effect was observed, previously claimed as faster RTs and smaller amplitude of the N400 component. We hypothesizes that the cognates are common abstract representations that link word forms in each language, therefore if the bilingual lexicon is unified across languages, the resting levels of activation for cognates should be fed from both languages and that is why a cumulative cognate frequency can be observed.

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### Is L2 Learners' Indirect or Direct Access to L2 Word Meanings Only Modulated By L2 Proficiency? Evidence from German Learners of English.

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We tested the predictions of the Revised Hierarchical Model (RHM, Kroll & Stewart, 1994; see discussions by Brysbaert & Duyck, 2010; Kroll et al., 2010) by examining how young adult L2 learners

with varying L2 proficiencies performed a translation recognition task with semantically related and unrelated incorrect translations between English and German. The RHM predicts that with growing proficiency L2 learners gradually move from accessing L2 word meanings indirectly via the L1 translation equivalent to direct conceptual mediation via the conceptual link, in turn becoming more sensitive to semantics. Forty-five German L2 learners of English (mean age = 23) with varying L2 proficiencies and varying daily English usage took part. Preliminary results indicate significantly slower RTs and lower accuracies for semantically related than for unrelated stimuli. Critically, this semantic interference effect is linked more to daily usage of English and less so to L2 proficiency. This finding expands the RHM's predictions and indicates that, beyond L2 proficiency, daily L2 usage modulates how extensively L2 learners exploit conceptual information during translation recognition. It also provided evidence that learners increasingly map L2 word forms to concepts depending on their active and regular usage of the L2.

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### Comprehension Monitoring in Critical Adjectives: The Role of Animacy.

ANA I. PÉREZ, *University of Poitiers*, TERESA BAJO, PEDRO MACIZO, *University of Granada*. To evaluate the role of animacy in semantic processing, event-related potentials (ERPs) were recorded while participants read Spanish sentences that presented a critical word (i.e., an adjective). In the context of each sentence, this adjective could be semantically incongruent in one of two different ways: a) without animacy violation, where the semantic incongruence was generated by a lack of general sense of the sentence (e.g., *La joven corría porque estaba trajeada* – *The young woman run because she was well dressed*); and b) with animacy violation, where the semantic incongruence was due to a disruption of animacy between the critical adjective and a noun (e.g., *Los jóvenes acudieron a la cita trajeada* – *The young men went to the "well dressed appointment"*). In addition, the congruent version of each sentence was also provided (e.g., *La joven acudió a la cita trajeada* – *The young woman went to the appointment well dressed*). Participants were required to verify if each sentence was congruent or incongruent. Compared with congruent sentences, semantically incongruent sentences *without* animacy violation modulated the N400 component, while semantically incongruent sentences *with* animacy violation modulated the P600. These results demonstrate that while pure semantic incongruences only reflect difficulty to integrate the critical adjective into the context of the sentence (N400), semantic incongruences containing animacy violation also require a syntactic reanalysis (P600). These results are consistent with Kuperber's model of distinct but interactive neural processing streams (Kuperberg, 2007). Email: Ana I. Pérez, [antiterrenal@gmail.com](mailto:antiterrenal@gmail.com)

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### The Relationship between Dyslexia and Birth Weight in Elementary School Students.

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Dyslexia, also known as specific reading disorder or alexia, is a learning disability characterized by trouble reading, spelling



or writing despite a normal intelligence. This study aimed to relationship between dyslexia and low birth weight in primary school students. This study was experimental method and sample consisted of 30 Dyslexic and 30 normal elementary students that were same in age, cultural and economic characteristics (n=60) at the elementary schools of Babol. To collect the data used from the Reading & Dyslexia Test and Wechsler Intelligence Scale for Children(WISC) for assessment Dyslexia and intelligence. Also Vaccination card for birth weight. For data analysis descriptive statistics, independent-samples T Test and Pearson correlation coefficient were used. Based on the result of the study, it was seen that a significant relationship between dyslexia and birth weight so Dyslexia students had low birth weight than normal students.

**Key words:** Dyslexia, Birth weight, Elementary students, Intelligence

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### **An Event-Related Potentials Study of Causal, Emotional and Location Inferences.**

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Previous event-related potential studies have demonstrated the online generation of inferences during reading for comprehension tasks. The present study, contrasted the brainwave patterns of activity within the same participants to the fulfilment or violation of various types of inferences (causal, emotional, location). Relative to inference congruent sentence endings, a typical centro-parietal N400 was elicited for the violation of causal and location inferences. This N400 effect was absent for emotional inferences. Between 500-750 msec, a larger frontal positivity was elicited by inference incongruent sentence endings (pN400FP) in the causal condition. In emotional sentences, both inference congruent and incongruent endings exerted this frontally distributed late positivity (pN400FP). For the violation of location inferences, the larger positivity was only marginally significant over left posterior scalp locations. Thus, when inferences were violated not all inference inviting sentences evoked a similar pattern of ERP responses. We interpret and discuss our results in line with recent views on what the N400, the P600 and the pN400FP potentials index.

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### **Cognitive Processes Involved in Sentence Comprehension in Spanish/English Code-Switchers: An ERP Study.**

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Psycholinguistic research shows cognitive costs when bilinguals switch languages. However, some bilinguals spontaneously switch languages (code-switching) even within the same utterance, suggesting that under some circumstances, switching does not incur a processing cost. To investigate this, we examined the neurophysiological correlates of code-switching during sentence comprehension in highly proficient Spanish/English bilinguals and compare it with switching into unexpected same-language words

(lexical switching). Eighteen participants read sentences in which the semantic expectancy (high vs. low) and the language context (switch vs. non-switch) of the critical word were manipulated. By crossing both variables we can distinguish the costs related to lexical unexpectedness from those related to code-switching, and how they interact. We compared neural activity at 250-550 and 550-750ms post critical word to discern the cognitive processes involved in each switch. As expected, we observed a negative deflection at around 400ms (N400) for low expectancy compared to high expectancy sentences. However, switching the language elicited a positivity at the early and late time-windows (P300/LPC complex). Critically, direct contrast of lexical switches and code-switches revealed an N400 to lexical switches. A novel comparison in this type of studies, the combination of lexical and code-switch compared to lexical switch without code-switch shows an N400/LPC complex. Our results replicate previous studies and demonstrate that code-switches may cause a reduced cost in sentence comprehension compared to lexical switches. In addition, unexpected words that switch languages are associated with greater processing difficulty (N400). This suggests that the reduced cost to code-switches is modulated by semantic fit.

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### **Effects of Transcranial Direct Current Stimulation with Cognitive Therapy in Patients with Non Fluent Aphasia Disorder.**

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Introduction: Aphasia after stroke in the left hemisphere, is a common symptom. These people are often incomplete recovery intensive speech therapy experience. Direct electrical stimulation of the brain, which is a technique to stimulate the brain in neurological and psychiatric patients used. The aim of this study was to investigate the effects of stimulation with cognitive therapy on recovery of naming ability, working memory, and the non-fluent aphasia patients with aphasia and its effects were lasting.

Methods: In this interventional study was conducted in 10 patients with non-fluent aphasia after stroke were selected. Ratings of Aphasia quotient, working memory and naming ability to call them four times before and after treatment, after sham and two months after treatment was compared. 10 sessions of sham electrical stimulation (20 min) with cognitive therapy and anodic and cathodic stimulation of 10 sessions per patient (2 mA - 20 minutes) with cognitive therapy in the dorsal lateral prefrontal cortex received. Data analyzed was performed using ANOVA material with repeated measurements and friedman nonparametric test.

Results: The data showed that the ability of naming, working memory in non-fluent aphasia patients after treatment and Two months after treatment compared with sham has grown significantly (p <.05) However, no significant improvement of aphasia quotient.

Conclusions: The results of this study seem to transcranial direct current stimulation with cognitive therapy can Sustained improvement in naming function and working memory in patients with non-fluent aphasia is and can be used in the rehabilitation of these patients.

Key words: Transcranial direct current stimulation, Non fluent aphasia, working memory

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### Can the Vowels of a Brand Name Affect How the Product Is Construed? Not in Spanish - Failure of Replication of Maglio et al. (2014, Exp. 3).

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Construal level theory proposes that every concept (e.g., an ice cream) can be understood at different levels, from a low level that includes more accessory perceptual and motor details (e.g., the feasibility of obtaining it) to a high level including essential features (e.g., its desirability). Maglio et al. (2014) hypothesized that front and back vowels should induce a low or high construal level, respectively. In their Experiment 3, they presented descriptions of an ice cream, named either Frish (front vowel) or Frosh (back vowel). One kind of description included a positive high-level characteristic (high desirability: great taste) and a negative low-level characteristic (low feasibility: difficult to obtain). The second kind reversed the valence of the characteristics (not so good taste, but easy to obtain). Participants always preferred the good tasting ice cream, but its advantage over the easy but not so good ice cream was reduced when the name contained a back vowel (Frosh). Because of the theoretical and applied importance of these findings, we decided to replicate them in Spanish. We run two very close, highly powered (total N=297), pre-registered replications. The first one tested participants in groups, while the second tested them individually. We failed to replicate the interaction between name and condition, neither in each independent replication nor in their combined data. We conclude that, at least in Spanish, sound symbolic effects from vowels in brand names do not extend into the level of construal of the product.

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### Native-Language Tones Influence Lexical Access in the Second Language.

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Bilinguals' perception of acoustic-phonetic features in their second language is often influenced by properties of their native language. Research on L2 processing of segmental information (i.e., phonemes) has shown that the influence of L1 on L2 perception extends beyond phoneme processing to lexical access. Using an eye-tracking task, we show that the effect of L1 experience on L2 processing seen in phoneme perception can be further extended to tone processing. In an eye-tracking task, Mandarin-English bilinguals (N = 17) heard spoken English words and selected which of two visually presented Chinese characters referred to the correct Mandarin translation. To test listener's sensitivity to L1 tonal information during L2 processing, the pitch contour of the spoken English word was manipulated to either match or mismatch the lexical tone of the Mandarin translation. Results revealed that bilinguals were significantly faster to correctly identify the target translation, and made earlier eye-movements to targets, when the tone information of the word spoken in English matched that of its Mandarin translation. The results provide compelling evidence that bilinguals' are sensitive to relevant suprasegmental tone information and use this information during lexical access, even when listening to a non-tonal language. Bilingual listeners' appear to use all available information, including their experience with

native-language lexical tone, to benefit second language speech perception. Thus, our findings are consistent with interactive accounts of language processing, and have implications for theories of language interaction and second language learning.

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### Sub-lexical Components of Chinese Character Recognition: An ERP study on the Effects of Logographeme and Radical Independence.

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Chinese compound characters are automatically decomposed into sub-lexical components referred to as radicals during reading and writing. However, studies investigating writing errors in children and aphasic individuals argue that logographemes, a smaller sub-lexical unit than the radical, are the core representational units. To assess whether logographemes are encoded during character recognition, two lexical decision tasks together with event-related potential measures was conducted. Real characters varied factorially by character frequency (high vs. low) and logographeme independence (independent vs. non-independent) in Exp1. Independence refers to whether or not the logographeme could exist as a real character. Results showed that non-independent logographemes elicited a greater positivity than non-free-standing logographemes at the P100 component in real characters. However, given that some logographemes can also exist as radicals, Exp2 investigated whether logographemes differ from radical representations. Pseudo-characters that varied by radical-level independence (independent vs. non-independent radicals) and logographeme-level independence (independent vs. non-independent logographemes) were used. A smaller P100 positivity followed by greater N170 negativity was elicited for pseudo-characters with independent radicals. In contrast, non-independent logographemes evoked greater negativity at the N170 component. The findings suggest that independent logographemes are more readily accessed and recruit less neuronal resources during early visual encoding and orthographic analysis. However, logographeme activation depends on the type of characters encountered, with more automatic analytical-like processes during real word recognition but in a holistic-to-analytical manner when identifying pseudo-characters. Importantly, logographeme representations are likely to be independent from radical representation, and challenge Character recognition models that do not assume a logographeme representational level.

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### The Influence of Syllabic Structure in Rule Learning.

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The syllable is a basic processing unit in speech, used to segment the signal and access the lexicon. Rule learning is a basic mechanism by which we can extract regularities from a speech stream over adjacent or non-adjacent segments as syllables or phonemes. Here we wanted to explore whether our representations of syllabic structure modulate how we extract abstract structures from speech. In a series of experiments, participants (N=17 in each experiment) listened to a stream of trisyllabic non-sense words that followed an ABB rule over syllables (Experiments 1a-d) or over vowels (Experiments





2a-d). They were then presented with a two-alternative forced choice (2AFC) generalization test where the syllabic structure was modified (e.g. going from CV during familiarization to either CVC or CCV during test). Results show that subjects generalized the abstract rule in all the experiments. Performance in the experiments where the rule was implemented over syllables was higher than performance in the experiments where the rule was implemented over vowels. However, we did not observe any effect of changes in syllabic structure from familiarization to test. This suggests the syllable was not modulating the extraction of the abstract patterns over the syllables or the vowel segments.

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### **Predictions of Lexical Norm Data Obtained Using Word Associations and Word Collocation.**

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Introduction: We compared the quality of prediction of word variables based on a Dutch word association corpus and a text corpus. We derived estimates for three affective word variables: valence, arousal, and dominance, and two non-affective word variables: concreteness and age of acquisition (AoA). Material and methods: For 2,831 words with ratings on each variable, we used three methods to generate the predictions. All three methods rely on the similarity between pairs of words, which was obtained both using word associations and word collocation: (1) using projections on a dimension identified as the variable in question through property fitting in a multidimensional representation of the pairwise similarities, (2) using the mean of the variable for the k-nearest neighbors determined by the pairwise similarities, and (3) using the k-nearest neighbors values, weighted according to their proximity. Results and Conclusions: For all variables except concreteness and AoA, estimates were superior when based on word associations. Differences between the predictions of the three methods were small, although method three consistently yielded the best predictions. Based on the word association corpus it yielded correlations of .92, .85, and .85, for valence, arousal, and dominance, respectively. Its corresponding correlations based on the text corpus were .80, .74, and .67, respectively. For concreteness and AoA, both the association and the text corpus yielded correlations of .88 and .73, respectively. Based on these results, we believe word associations are better at capturing human ratings of affective word variables.

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### **Aging of Word Frequency, Syllable Frequency and Phonological Facilitation Effects in Chinese Speech Production: An ERP Study.**

QUN YANG, QINGFANG ZHANG, Renmin University of China. Effects of word frequency (WF), syllable frequency (SF), and phonological relatedness in picture naming were investigated systematically in speech production domain, and the facilitation effects have been observed in young speakers. Now, the aging of speech production in Chinese via comparing above-mentioned effects between the young and the old speakers was investigated.

The ERP technique was used to examine the time course of these effects. WF and SF of picture names, and the distractor words phonologically related or unrelated to picture names were manipulated in the picture-word interference task. Nineteen young (Mage=22.6) and 17 old speakers (Mage=68.5) participated in the experiment, and they were asked to name pictures while ignoring distractors. The facilitation effects were all observed in young and old groups, but WF and SF effects size were larger in the old, while the phonological effect smaller. Critically, the interaction pattern of WF and SF in the old was found but none in the young. According to the ERP data, it indicates that WF and SF effects arose in the time window of lexical selection and phonological encoding respectively in the young. Both effects arose later in the old, indicating that all processing stages of speech production were slowed down in the old. The young speakers present a discrete pattern while the old present a cascading pattern in speech production.

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### **Revisiting the Role of Semantic Radicals in Chinese Character Reading: The Interaction of Semantic Transparency and Imageability.**

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Semantic transparency refers to the extent to which the Chinese character shares meaning with its semantic radical (e.g. transparent character 碑 “stone monument” and opaque character 碗 “bowl” both contain the semantic radical 石 “stone”). Transparent characters are easier to process in semantic tasks; however, the issue has not been conclusively studied because semantic transparency is typically correlated with imageability. In this study, ratings of imageability were collected from 20 raters and its effect on semantic judgment was statistically controlled. Thirty native Cantonese speakers participated in a semantic categorization task in which transparency and category membership (objects or actions) were manipulated in a fully-crossed design. Ratings indicated that objects were more imageable than actions, and high imageability predicted higher accuracy and faster RT. In the action category, the by-subject analysis (ANOVA) not controlling for imageability showed transparency effects, with higher accuracy and lower RT for transparent characters. However, when imageability was entered as a covariate in ANCOVA, the effect of semantic transparency was no longer evident. Instead, imageability significantly predicted both accuracy and RT. In contrast, for the category of objects, regardless of imageability, a reverse transparency effect was observed, with lower accuracy and higher RT for transparent characters. A possible explanation might be that opaque characters tended to represent more common objects, although overall lexical frequency was matched. Thus, the present results suggested that imageability might be contributing to the apparent semantic transparency effects, and concept familiarity might be another confounding factor.

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## Learning and Memory

(74)

### Negative Items Impair Associative Memory and the Coherence of Episodic Memories.

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Experienced events involving multiple elements are thought to be stored in episodic memory as coherent representations. At retrieval, all elements from an event are reinstated following presentation of a partial cue, via a process of pattern completion. Whilst emotional items can strongly impact memory, it is unclear how they interact with the binding of elements within an event. In a series of experiments, participants encoded multiple events, each comprising three elements (ABC; pictures of locations, people and objects), through presentation of sequences of overlapping pairwise associations (e.g. A-B, B-C, C-A). Half of the events contained a negative image (e.g., an injured person). Associative memory for pairs was impaired by the presence of a negative element, compared to neutral pairs, irrespective of whether they formed part of a neutral or negative event. Whilst neutral events were remembered coherently (all retrievals from the same event show statistical dependency), this was reduced in events containing a negative image in the initial pair of elements. Our results suggest that retrieval from neutral events is supported by pattern completion, but a negative element weakens associative encoding, preventing the formation of a coherent event representation containing it. Email: James Bisby, [j.bisby@ucl.ac.uk](mailto:j.bisby@ucl.ac.uk)

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### Working Memory Impairments: Causes and Responses to Training across Specific Learning Difficulties.

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It is not yet clear whether different profiles of working memory (WM) deficits associated with specific learning disorders represent core cognitive difficulties. WM relies on efficient sensory inputs and is part of a network of higher-order cognitive control functions. Impairments in any of these related systems will impact on WM performance. The aims of this study were i) to identify the potential source of WM problems in children with specific difficulties in maths (MD), in reading (RD) or in both reading and maths (MDRD) and ii) to investigate whether WM training alleviates these difficulties. Children with MD, RD, or MDRD, and a comparison group with normal reading and maths skills completed a battery of tasks designed to assess the cognitive systems associated with WM before and after training. This included parallel verbal and visuo-spatial tests of information processing, short-term memory (STM), WM, selective attention and inhibition. All three groups were characterised by impairments in phonological processing. The RD group had additional deficits in verbal STM, while MDRD children were characterised by a broader profile of impairment that extended to visuo-spatial processing and verbal and visuo-spatial STM and WM tasks. Following training, improvements were observed in phonological processing and visuo-spatial STM for the MD group. The RD group showed no improvements following training, while the MDRD group gained on the verbal WM measure. This data suggests that WM difficulties may occur downstream of

information processing problems and that interventions targeting these problems may be more appropriate than WM training.

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### A Test of the Arousal-biased Competition Account of Emotional Memory.

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The arousal-biased competition model (Mather & Sutherland, 2011) assumes that arousal positively biases currently relevant processing goals at the cost of goals with lower priority. In the case of episodic memory this account suggests that arousal should disproportionately enhance memory for features which are in the focus of attention during encoding as compared with features which are not in the focus of attention. Although this model could provide an account of the diverse effects of emotional arousal on episodic memory a stringent test of this particular prediction was lacking. In the present research this prediction was tested experimentally by manipulating the processing focus during encoding of low and high arousing pictures (taken from the IAPS). To manipulate context, the pictures were presented on two different background patterns and in two different spatial positions. Participants were asked to either just view the pictures, encode only the background pattern along with the pictures, encode only the spatial position along with the pictures or encode both feature dimensions along with the pictures. Instructions to selectively encode one of the two feature dimensions resulted in selectively increased memory for the respective feature dimension. However, contrary to the prediction of the arousal-biased competition model, arousal did not enhance this effect. Thus, this preliminary test yielded no evidence for the arousal-biased competition account of the effect of arousal on episodic memory.

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### Searching for the Pavlovian Trace: Neural Patterns in the Right Amygdala Distinguish Experience-Based from Instructed Fear.

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Although it is commonly thought that fear can be learned through different pathways – via experience or via instructions –, earlier studies looking into the neural correlates of experience-based or Pavlovian fear in humans could not control for the effects of verbal instructions or conscious appraisal. The present functional magnetic resonance imaging (fMRI) study adopted a newly developed paradigm that allows for singling out the purely experience-based components of a combined instructed and experientially learned fear reaction by contrasting this condition with a merely instructed fear reaction. We investigated differentially responding neural patterns of brain activity using multi-voxel pattern similarity analysis and identified the right amygdala as the only fear-associated region that responds differently to instructed-and-experienced versus merely instructed fear.

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### At the Root of Propection: Mental Time Line and Mental Number Line as Predictors of Children's Future Thinking.

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In the last years, growing attention has been devoted to the study of the role of a Mental Time Line (MTL) in supporting the ability to project oneself mentally to a moment in the past or future (Propection). However, when and how these complex cognitive abilities emerge and then develop in children is still controversial. The present study fits into this scenario, which has been scarcely explored, in an attempt to clarify: a) The relationship between the Mental Time Line and the Mental Number Line in children aged 4 to 7; b) The orientation of the Mental Time Line in children who have not yet acquired the skills of reading and writing; and c) The relationship between Mental Time Line and future-oriented thoughts (Propection). Twenty children aged 4 to 5 years and 20 children aged 6 to 7 years were administered four tasks: A *Number to Position task*, a *Time to Position task*, a *Mental Time Line task* and a *Propection task*. Results showed that the MTL is related with Spatial Skills (Mental Number Line), that the MTL orientation appears to be bound and conditioned by the skills of reading and writing, and that as performance in the MTL and in the MNL improves, so does performance in the Propection task. We, therefore, suggest that children's propection skills are rooted in the development of a mental time line and a mental number line.

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### Validation of the Working Memory Power Test for Children.

KERRY A. CHALMERS, EMILY E. FREEMAN, *University of Newcastle.*

Low working memory capacity is related to poor performance on tests of literacy and numeracy. This study investigated the validity of a newly developed test of working memory, the Working Memory Power Test for Children (WMPT). Convergent validity was assessed by examining the relationship between performance on the WMPT and on the Automated Working Memory Assessment (AWMA) short form. The ability of the WMPT to predict performance on the Wechsler Individual Achievement Test (WIAT-II) Australian abbreviated was used as a measure of concurrent validity. 167 Australian school children aged between 8 years, 8 months and 11 years, 7 months completed two assessments of working memory (WMPT and AWMA) and three measures of academic achievement (word reading, spelling and numerical operations subtests of the WIAT-II). Strong correlations between the WMPT and AWMA total scores were found, indicating good convergent validity. Moderate correlations between the WMPT total score and each of the four AWMA subtests assessing short-term and working memory in the verbal and visuospatial domains were also observed. WMPT scores predicted academic achievement in reading, numeracy and spelling, suggesting good concurrent validity. Compared with the AWMA, the WMPT explained a higher proportion of the variance in academic achievement as measured by the WIAT-II. The WMPT is an easy-to-administer test of working memory with good psychometric properties. With additional research to establish norms across a wide age range, this test could be valuable as a screener to identify

children at risk of lower levels of academic achievement. Email: Kerry Chalmers, [kerry.chalmers@newcastle.edu.au](mailto:kerry.chalmers@newcastle.edu.au)

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### Does Perceived Control Over the Experienced Life Events Affect the Reminiscence Bump?

BERIVAN ECE, *MEF University*, SAMI GULGOZ, *Koç University.*

The primary objective was to examine the presence of the reminiscence bump in lifespan retrieval of autobiographical memories as a function of the perceived control. A total of 83 (43 male) Turkish adults over 50 years old ( $M=61.55$ ,  $SD=5.19$ ) provided their autobiographical memories and rated them in terms of various event qualities such as importance, emotional valence, effect on the current identity, and perceived control over the experienced life event. For each reported memory, they further reported their ages at the time of the experience. Overall data displayed the regular reminiscence bump in lifespan distribution of autobiographical memories with the higher recall of life events from the life period between the ages of 15 and 30. However, when these events were further categorized in terms of the perceived control over the experience as reported by the participants, the bump was observed only for the life events that are considered to be high in perceived control. No reminiscence bump was obtained in the distributions of life events with low and moderate levels of perceived control. Current results supported earlier studies displaying the reminiscence bump only for the autobiographical events with high-perceived control. Findings and implications are discussed on the basis of different theoretical accounts of the reminiscence bump.

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### Avoidance Habit Acquisition in the Laboratory.

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Many mental disorders are characterised by the presence of compulsive or uncontrollable behaviours. Studying habit acquisition can help us to improve our understanding of this type of mental disorders. Most studies on habit learning are based on positive reinforcement paradigms. However, behaviours, compulsions and habits involved in some mental disorders may be better understood as avoidance behaviours, which involve some peculiarities, such as anxiety states, that have been shown to promote habitual responses. Therefore, we decided to use a free-operant discriminated avoidance procedure to study habit acquisition. During the task, participants had to learn to avoid an aversive noise presented either to the right or to the left ear by pressing two different keys. After a devaluation phase, where participants could experience how the volume of the noise presented to one of the ears was reduced, participants went through a test phase identical to the avoidance learning phase, except for the fact that the noise was never administered. Habit acquisition was inferred by comparing the rate of responses to the stimulus signalling the devalued reinforcer and to the stimulus signalling the non-devalued reinforcer. Habitual responses would entail the absence of differences between the two conditions. Finally, we discuss the theoretical and clinical implications of our

results.

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### Differential Consolidation Mechanisms Are Involved in Declarative vs. Non-declarative Form of Probabilistic Sequence Learning.

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The acquisition of several motor, cognitive and social skills is based on the recognition of sequential elements and patterns in the environment. These processes can occur with or without awareness. Previous studies have shown that delay between learning sessions leads to forgetting in declarative/explicit memory tasks, while performance is retained in non-declarative/implicit memory tasks after an offline period. The aim of the present study was to compare the consolidation of explicit and implicit sequence knowledge. Ninety healthy young adults participated in the experiment. Learning was measured by the alternating serial reaction time (ASRT) task and retested 12-hour later. Half of the participants were informed about the probabilistic sequence structure of the task, and were asked to use this knowledge to improve their performance (explicit group). The other half of the participants were unaware of the sequence structure (implicit group). These groups were further divided into two subgroups based on whether they slept between the two sessions (PM-AM groups) or stayed awake (AM-PM groups). Here we found no effect of sleep; however, the type of instruction affected the consolidation of sequential knowledge differently. While the performance was retained after the 12-hour delay in the implicit group, the explicit group showed forgetting. Our findings are in line with the growing literature on different characteristics of declarative and non-declarative memory systems, and extend it to probabilistic sequence learning and consolidation. Email: Karolina Janacsek, [janacsekkarolina@gmail.com](mailto:janacsekkarolina@gmail.com)

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### Enhancing the Testing Effect.

MASHA JONES, SUSANNE M. JAEGGI, *University of California, Irvine*.

Research in cognitive and educational psychology has demonstrated that popular study techniques such as highlighting and rereading are largely ineffective. Furthermore, students are typically inaccurate in their estimations of how well they have mastered material and how efficient their study methods are. Thus, it is important to develop and teach instructional techniques that effectively support student learning. In our study, undergraduates were encouraged to write their own multiple choice quiz questions. Our findings show that writing such questions supports performance on multiple choice tests but not on essay tests. This suggests that writing one's own quiz questions is an effective task-specific strategy for improving one's grade, but that the benefits of this strategy do not necessarily extend to new contexts.

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### The Effect of Post-Identification Feedback on Showup Identifications.

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This study examined the effects of post-identification feedback on witness retrospective self-reports and, for the first time, included showups and a designated innocent suspect. Post-identification feedback is any information given to the witness about the accuracy of their identification, and affects a wide range of eyewitness self-reports about confidence, attention, willingness to testify, etc. We expected that because showups have greater demand characteristics than lineups, the feedback effects would be enhanced for showup witnesses. Conversely, we expected smaller effect sizes for witnesses who chose the innocent suspect because he is closer in appearance to the perpetrator than other lineup fillers. After viewing a mock crime video, participants were asked to identify the suspect from either a target-present or target-absent photographic lineup or showup. Following their identification, participants were either given confirming feedback indicating that they had made the correct decision, or were given no feedback. In both showups and lineups, participants who received confirming feedback had higher ratings for confidence, attention, and willingness to testify than the no feedback group. However, we found no differences between lineups and showups, and no difference in effect size for the innocent suspect witnesses. Importantly, this study provides evidence suggesting that the cue accessibility framework that has traditionally been used to explain the feedback effects may be insufficient.

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### It Looks Familiar but I Don't Recollect: Repetition Affects Recognition Memory Differently in Children and Adults.

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There is extensive debate whether recognition memory is better described by a single- or dual-process model (Berry et al., 2011). Surprisingly, this debate has barely been tackled from a developmental perspective. We present research showing that developmental evidence can contribute to the question of whether there are two processes underlying memory. In two experiments, 5-, 7-, and 11-year-olds ( $N = 160$ ) completed a modified process-dissociation paradigm (Jacoby, 1991). Participants encoded a series of pictures presented once or three times either at the top or the bottom of the screen. Recognition consisted of an inclusion (old/ new recognition test) and an exclusion phase (only items earlier presented on the top of the screen had to be accepted). By contrasting performance in inclusion (based on familiarity) and exclusion (recollection required), recollection and familiarity parameters were estimated, using a formal modelling approach. Recollection increased with age, in contrast to familiarity, which remained stable across all age groups. Further, in young children repeated item presentation mainly increased familiarity, whereas in older children both familiarity and recollection were enhanced. Converging evidence was found in a second experiment in which a





response time limit decreased recollection while leaving familiarity unaffected. In sum, we show a double-dissociation of recollection and familiarity throughout childhood after repeating items at encoding and limiting response time at retrieval. Together with the distinct age-related increases for recollection and familiarity, this is consistent with dual-process assumptions of recognition memory and suggests that familiarity and recollection are independent processes already in childhood.

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### **The Effects of Working Memory Updating Training in Younger Adults.**

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Working memory updating (WMU) is an essential process of our mental architecture and it is involved in a wide range of everyday complex tasks. It is therefore not surprising the increasing interest in examining the efficacy of WMU training. The present research aimed to assess the benefits of two training interventions using the same WMU tasks with different cognitive demands. Fifty university students were randomly assigned to an adaptive group that performed two numerical WMU tasks for four sessions and to a non-adaptive group that practiced the same WMU tasks with a lower

and invariable demanding level. To assess transfer effects, measures of WMU, working memory and fluid intelligence were collected before and after the training. Maintenance benefits after a month were also assessed. Training gains were found in most of the tasks and were maintained one month later. Some transfer effects were greater for the adaptive than for the non-adaptive group in measures related to the trained tasks. The results suggest the possibility to train WMU obtaining specific gains and transfer effects to tasks that share processes with the trained ones. Furthermore, the superiority of the adaptive group suggests that the degree of improvement is related to the WM demands imposed by the training tasks.

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### **Individual Differences on Motivation and Attention in Working Memory Training in Elementary School Children.**

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Working Memory (WM) plays a central role in Reading Comprehension (RC), and because of its plasticity, it has been shown that Working Memory can be trained. Working Memory Training (WMT) can result in improvements in essential functions of the learning process such as Reasoning and especially, RC. Recent research has shown that individual differences in motivation and attention maintenance during training interventions can modulate the magnitude of the training transfer. We aimed to study how these individual differences can influence the training improvement in elementary school children. In a randomized controlled trial

we have measured self-reported motivation; attention and need of supervision across 10 training sessions in 4<sup>th</sup> and 5<sup>th</sup> grade students. Children were randomly assigned to either a WMT or a control training condition, and were pre and post-test evaluated in WM and RC abilities. Data are currently being collected at two elementary schools in California. Collection in the first school is already finished, and preliminary results indicate that motivation and attention correlates with cognitive training improvement across the sessions. We suggest that motivation and attention maintenance across training sessions may represent an essential factor to assure WMT efficiency.

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### **Imagery in Memories Predict Affective and Psychological Distancing.**

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The present study investigated the role of major recollective features, imagery and reliving, on the emotional intensity and the perceived temporal distance when remembering past events. We focused on memories for events related to achievement and failure. We examined differences other than the valence of such events, such as the possible functions of remembering past goals. Events related to past, not the current, goals were selected since individuals were more likely to experience closure and distancing for these memories. We asked participants ( $N = 261$ , 141 female) to report an important memory of past goals they either failed or achieved, and then to rate the phenomenological properties and temporal distance for the reported memory. We used structural equation modeling approach to test the role of imagery and reliving on the relationship between event characteristics and affective and temporal distancing. We found that, irrespective of the memory type, imagery was found as the major mechanism explaining the influence of self-definingness on psychological distance. Highly self-defining memories were remembered with more imagery and that's why individuals perceived these memories psychologically closer. We also found a mediation pattern predicting current emotional intensity, suggesting that high event intensity predicted remembering with more imagery and reliving, which resulted in current intensity to be higher as well. However, this pattern was found only for failure-related events. Results are discussed from a functional perspective of autobiographical memory.

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### **Intentionally Forgetting Words and Images in a Changing Environment.**

DIANA ORGHIAN, LEONEL GARCIA-MARQUES, JOÃO BRAGA, *University of Lisbon*. Research shows that humans are able to learn certain information while ignoring and/or forgetting other. The goal of the present 2 studies was to further understand how efficient some of our learning intentions and processing strategies are and how are they influenced by irrelevant information present at the encoding moment. Using an item-method directed forgetting paradigm, participants attended either words or pictures while an irrelevant stimulus (also either word or picture) was presented as a context. Instructions to remember the attended item (to-be-remembered, TBR) lead to higher recognition rates than instructions to forget the attended item (TBF). However, these instructions did

not affect the irrelevant items, thus, conceptually replicating the results of Taylor & Fawcett (2012). Memory for pictures was also overall better than for words – the typical picture superiority effect. More interesting is the fact that the irrelevant information was better learned when the attended items were TBF than TBR, regardless of the type of attended (word or picture), but it is only true for irrelevant words, and not irrelevant pictures. Thus, we observed that when the recognition test was about the attended items, there were more false alarms for the new targets accompanied by old words from Forget trials than old words from Remember trials. For the old attended targets there was no such context effect since the response was mainly driven by the familiarity with the target.

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### Improving Memory Inhibition: A Study of RIF, Executive Control and Aerobic Fitness.

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Aerobic exercise is being established as a prospective way to enhance executive functions and prevent cognitive aging. Given that previous studies have shown that active participants present with better cognitive and interference control, we aimed at investigating whether aerobic exercise would also modulate interference control in retrieval processes. Active and passive participants carried out a dual retrieval-forgetting task (Ortega, Román, Gómez-Ariza & Bajo, 2011) combining working memory with retrieval. The results showed that while active participants were able to suppress the interference produced by competitive targets despite the working memory load, passive participants were not. The opposite pattern was observed for the facilitation effect. These results are discussed in terms of the inhibitory model of forgetting (Anderson, Björk, & Björk, 1994; Levy & Anderson, 2002).

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### Adaptive Memory: Enhanced Source and Indirect Retention of Long-Term Potential Mates.

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Evidence that memory works better for information processed in a mating context is accumulating. Female participants rated the desirability of potential male candidates either in a long-term mating or team-worker context. Each candidate was represented by a face and a descriptor – a desirable, an undesirable or an irrelevant characteristic. After rating each third item, each descriptor was presented back along with the three just presented faces and the participant had to decide which face had been presented with that sentence (procedure repeated 12 times; total of 36 stimuli). After a short distractor task, an old/new recognition and source memory (SM) task followed. During recognition, given an old response, a question appeared asking to identify the type of descriptor previously associated with it (SM). Source memory performance was better in the mating condition than in the worker condition. The same participants returned to the lab one week later for an allegedly unrelated task. In this task, all the previously used faces were presented and participants were asked to rate how desirable each

face would be if they were looking for a long-term mating or a long-term team-worker relation. A significant effect of type of descriptor previously associated to the face occurred in the mating condition: faces previously associated with undesirable descriptors were rated as the least desirable. Thus, we report an immediate source memory effect of mate processing but also an indirect influence of this task in later assessments of individuals. These results argue for functionally-designed memory systems.

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### The Cognitive Interview: New Procedures to Further Enhance Witnesses' Report and Evaluate Accuracy.

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The Enhanced Cognitive Interview (ECI) is one of the most studied and used methods to interview witnesses, and has proved to be effective for very different situations. However, finding additional ways to enhance witnesses' report is crucial for police investigations. We focused on increasing recall even more with a new interview strategy, Category Clustering Recall (CCR), and evaluating report accuracy through metacognitive monitoring. We innovatively evaluated if such monitoring could be performed in a time-saving manner, i.e., if witnesses' spontaneous expressions of uncertainty and expressions of certainty could be used to evaluate eyewitness report accuracy. Sixty-six students watched a mock robbery video and were interviewed 48 hours later with either the (ECI), or the revised (ECI), with (CCR) instead of the Change Order mnemonic. Items of information were classified as (1) 'certainty' (e.g., 'I'm definitely sure he had gloves'), 'uncertainty' (e.g., 'I think he had gloves'), or 'regular recall' (e.g., 'He had gloves'); and (2) correct, incorrect or confabulation. Results showed that: participants interviewed with (CCR) produced more information without compromising accuracy; 'Uncertainties' were less accurate than 'regular recall', and their exclusion raised report accuracy; and 'Certainties' were more accurate than 'regular recall' and 'uncertainties'. Our findings support that Category Clustering Recall is a very effective recall strategy. Witnesses distinguished more reliable information ('certainties') from fairly reliable information ('regular recall') and less reliable information ('uncertainties'). Differentiating 'certainties' and 'uncertainties' are effective time-saving procedures to evaluate report accuracy. Professionals and researchers have now available new tools to enhance witnesses' report. Email: Rui Paulo, [laquatos@gmail.com](mailto:laquatos@gmail.com)

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### Social Transmission of Emotional Memory across Different Group Configurations.

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People frequently reminisce about emotional occurrences with others in social settings. Past research has shown the benefits and costs of emotional or social influences on individual memory, but less is known about the interactive effects of these two factors. This research aimed to investigate the retrieval and transmission of emotional and nonemotional information by examining 1) how social interaction via group collaboration shapes one's and a group's memory for emotional information, 2) how varying the



group members with whom one interacts over time can influence the transmission of emotional memory. Participants completed three consecutive recall sessions in one of three conditions: Individual–Individual–Individual (Control), Collaborative–Collaborative (Identical group)–Individual, and Collaborative–Collaborative (Reconfigured group)–Individual. When individuals recalled the stimuli alone repeatedly, the memory enhancement effect of emotion attenuated. However, when people repeatedly retrieved emotional memory with others in groups, the memory enhancement effect of emotion was reinforced and boosted, especially for negative information. Finally, people remembered more negative information than positive information when they were asked to recall information with the same group of people compared to a different group of people. Together, these findings converge to show that the retrieval and spread of emotional memory largely depends on whether the remembering of emotional experiences occurs in social or non-social context as well as on whether such experiences are shared with the same partners repeatedly or with a variety of collaborating partners.

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(94)

#### **Top-Down Control Reduces the Irrelevant Speech Effect on Serial Recall.**

JAN PHILIPP RÖER, RAOUL BELL, AXEL BUCHNER,  
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In four experiments we examined how much of the disruptive effect of irrelevant speech can be modulated by foreknowledge of the to-be-ignored distractor sequence. Participants remembered visually presented digits while ignoring background speech. In Experiment 1, the upcoming distractor sentence was presented auditorily and visually before the trial. When such specific foreknowledge was given, disruption was significantly attenuated relative to a condition without foreknowledge. This finding was replicated in Experiment 2, in which the upcoming distractor speech was only presented as a visual transcript on the computer screen in advance. Experiment 3 showed, however, that only specific foreknowledge is beneficial. The mere notification that an unspecified distractor sentence would be presented next had no effect on serial recall performance. In Experiment 4, there was only a small and nonsignificant reduction of disruption when lists of randomly selected words were used, suggesting that foreknowledge effects are more pronounced for coherent distractor sentences. Taken together, disruption of short-term memory by irrelevant speech does not appear to be immune to top-down control. A significant proportion of the effect can be modulated by knowing in advance what distractor sequence will be played next.

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(95)

#### **Intrusion-Based Interference in Short-Term Memory.**

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Detrimental effects of distraction on working memory (WM) and short-term memory (STM) may be due to the intrusion of irrelevant information into WM/STM. While some work has reported greater interference when distractors are similar to the contents of memory than vice versa, research using very simple stimuli has

found pronounced effects of distractors that are dissimilar to the contents of memory. In the present study, we produce the latter pattern of results using auditory pure tones as stimuli. Subjects were presented with a series of three auditory pure tones: A to-be-remembered target, a distractor, and a probe, and were asked to report whether the target and probe were of the same pitch. Critically, the frequency of the distractor was determined by the frequency of the target. When the target and probe were different pitches, subjects made more “same” responses when the distractor frequency was the same as the probe, rather than further away from the probe than the target frequency was. The results of this study support the notion of intrusion-based interference in WM/STM. We suggest that the effects of item-distractor similarity may vary depending on the complexity of the stimuli held in memory.

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(96)

#### **Understanding Metacognitive Inferiority on Screen: Exposing Media Sensitivity to Task Demands.**

Yael Sidi, RAKEFET ACKERMAN, Technion–Israel Institute of Technology.

Research inspired by the metacognitive approach has found screen inferiority in performance and metacognitive monitoring compared to paper when learning lengthy texts. Notably, this inferiority depends on task characteristics. The present study aimed to illuminate the conditions under which screen inferiority emerges. We used brief yet highly challenging problems to minimize the role of technological factors associated with lengthy reading on screen, while keeping the requirement for in-depth processing. The hypothesis was that the screen is more prone than paper to hints that legitimize shallow processing. In Experiment 1 time frame was manipulated. Time pressure resulted in screen inferiority in success rates and monitoring, while loose time frame yielded media equivalence. In Experiment 2, we manipulated task importance by presenting the problems from Experiment 1 as initial problems, designed as a learning phase for a following set of transfer problems. Consequently, the importance of the initial problems was reduced, as the transfer problems were expected to be perceived as the main task. Reduced task importance, similarly to time pressure, revealed screen inferiority. In Experiment 3, we examined whether these effects remain even when reading is extremely minimized, using three-word problems with a time frame manipulation. Indeed, under time pressure, screen inferiority in monitoring was still evident. Results indicate that computerized environments are more sensitive to task conditions that legitimate shallower processing than working on paper. Theoretical implications are drawn from the suggested role of the medium as a contextual cue for the recruitment of mental effort.

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(97)

#### **Taking Comfort in Not Knowing.**

LISA K. SON, SARA FRUCHTER, NINA PLOTNIKOV, Barnard  
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The objective of this research is to explore the Judgment of Not Knowing (JoNK), or the mechanisms for knowing that one does not know. In experiments 1 and 2, individuals were presented with a series of 50 trivia questions to which they had to answer “know” or “don’t know”. Reaction times (RTs) for making the judgment were

measured. If participants said “don’t know”, they also rated their confidence in their JoNK, on a slider scale. After all 50 questions had been responded to, each question to which participants had answered “don’t know” was presented again, along with the answer. Participants had to say whether they had never known it (novel) or whether it was once known (familiar). Results indicate two distinct JoNK: RTs for familiar items were longer than for novel items, which also had higher confidence judgments. In Experiment 3, we found the same pattern of results in a population in South Korea, challenging the hypothesis that cultures known to value effort would result in longer JoNK reaction times. In Experiment 4, middle school students solved either “high effort” or a “low effort” anagrams prior to participating in the JoNK paradigm. Results showed that those in the “high effort” group had longer RTs, regardless of whether the items were novel or familiar. We conclude that when making the JoNK, although people prioritize efficiency over effort, some amount of effort training or priming can shift that preference. Email: Lisa K. Son [lson@barnard.edu](mailto:lson@barnard.edu)

(98)

### **The Relationship between Autobiographical Memory and Acculturation: Earliest Memories of Adults Who Immigrated in Childhood.**

MERVE ÇAVUŞOĞLU, HASAN GÜRKAN TEKMAN, *Uludağ University.*

It is known that autobiographical memories are affected from cultural factors and societal transitions. In this study, age and phenomenological characteristics of the earliest autobiographical memories were investigated in a comparison between persons who immigrated in childhood and those who lived in the same country since they were born. Gender, repression, self construals, acculturation and social identification were also assessed for both groups. The immigrant group were born in Bulgaria and their family immigrated to Turkey when they were 2-6 years of age. The comparison group were born in Turkey to families who immigrated to Turkey before they were born. Participants told narrative of their earliest childhood memory and rated phenomenological qualities of the memories. Emotional valence, thematic, chronological, and contextual narrative coherence were also coded. In addition, participants completed Weinberger Adjustment Inventory, Acculturative Attitude Scale, Social Identification Scale, Self-Constraint Scale, and socio-demographic information form. The earliest memories were earlier for the immigrant group than the comparison group, but there were no differences in phenomenological characteristics. Also, there was not relationship between phenomenological characteristics and repression, immigration, acculturation, self construals, social identification. The study showed that the age of the end of childhood amnesia is affected by social transitions. E-mail: Hasan Gürkan Tekman, [hgtekman@gmail.com](mailto:hgtekman@gmail.com)

(99)

### **Living in History and Culture in Beijing: How Public Events, Personal Transitions, and Culture Affect the Organization of Autobiographical Memory in Chinese Older Adults.**

XUAN GU, CHI-SHING TSE, *The Chinese University of Hong Kong*, NORMAN R. BROWN, *University of Alberta.*

The “Living-in-History effect” occurs when people use public events as temporal references to support their date estimation of autobiographical memory. Though the effect has been examined in cross-cultural samples, little is known about its effect on the organization of autobiographical memory in Chinese. Our study is aimed to examine the roles of public events, personal transitions, and Chinese culture in the organization of Chinese older adult’s autobiographical memory. Using the two-phase Living-in-History paradigm (Brown et al., 2009), we interviewed fifty-three older adults in Beijing. The participants’ responses reflected the Historically Defined Autobiographical Periods (H-DAPs): they tended to organize their autobiographical memories around public events like Cultural Revolution (12% of all memories). Participants who were rusticated because of Cultural Revolution more frequently used H-DAPs as temporal landmarks, relative to those who were not rusticated [3.87(2.67) vs. 1.16(1.39),  $p < .01$ ]. The rusticated participants also rated greater materially (but not psychologically) transitional impact of the public event than their counterparts. Moreover, both personal transitions (e.g., moving house, job change) and life-scripted events registered in Chinese cultural life script (e.g., marriage, first job) were frequently used to date memories. Chinese older adults preferred to date their personal memories in relation to others’ (mostly their family members’) life-scripted events, transitional events, and developmental status. These findings suggested that (a) personal and collective transitions, which changed ones’ fabric of daily life, structure individuals’ autobiographical memories and (b) culture defines the normative transitions and the degree of including others into one’s autobiographical memories within that culture.

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(100)

### **Separating Cognitive Load Facets in a Working Memory Updating Task: An Experimental Approach.**

MARIA WIRZBERGER, MAIK BEEGE, SASCHA SCHNEIDER, STEVE NEBEL, GÜNTER DANIEL REY, *Technische Universität Chemnitz.*

Considering learners’ cognitive scopes and limitations exhibits broad impact on the design of instructional material. In this context, the influential Cognitive Load Theory postulates distinct facets that amount to the overall construct of cognitive load. While task complexity and learners’ previous knowledge constitute intrinsic load, extraneous load arises from inappropriate instructional design. Germane load represents relevant aspects of schema acquisition and automation. Those facets were supposed to operate additively, although more recent research queries such assumption. Since the valid examination of additivity requires separate and selective assessment of each facet, this research chooses an experimental approach to shed light on the controversial issue. A letter learning task related to the process of working memory updating was applied, manipulating facets strictly according to their theoretical definition. The resulting repeated-measures design





comprised 3 (task complexity) x 2 (split attention) x 2 (schema presence) factors and inspected performance of a student sample ( $N = 96$ ) referring to reaction times and errors in the updating and recall phase of the task. Approaching the results obtained in mixed-effects analyses, especially effects of task complexity gain substantial strength, whereas the other factors receive at least partial support. Interactions query the assumptions of separability and additivity of load-inducing factors. Results can be explained with regard to underlying mental operations and aptitude variables. Overall, the study comprises a promising approach for a valid empirical investigation of construction yards in cognitive load research.  
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(101)

### **Recognition Practice under Time Pressure Can Cause Retrieval-Induced Forgetting.**

YOHEI YAMADA, *Nara University of Education.*

I report an experiment examining whether recognition practice under time pressure can cause retrieval-induced forgetting. Forty-eight participants first studied a list of items and then, during recognition practice, were shown a subset of the studied items and asked to determine whether they had been previously studied by the 700-ms deadline. Following recognition practice, the final cued-recall test was conducted. The results showed that to-be-recognized items became more recallable, whereas related items from the study phase became less recallable. Moreover, this fast recognition-based retrieval-induced forgetting occurred regardless of whether distractor items were included during recognition practice and even when output interference was controlled at final test. This finding suggests that inhibition fulfills a role of resolving competition in a fast familiarity process.

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## **Sensation and Perception**

(102)

### **The Contribution of Motor Identity Prediction towards Intentional Binding.**

VICTORIA BART, UMIT-University for Health Sciences, Medical Informatics and Technology, DORIT WENKE, Pfh-Private University of Applied Science, MARTINA RIEGER, UMIT-University for Health Sciences, Medical Informatics and Technology.

Sense of agency can be measured implicitly via intentional binding, which refers to the perception that the interval between voluntary actions and their sensory effects is shortened (compared to involuntary actions and their effects). The present study aimed to investigate the influence of motor identity prediction (prediction of the identity of action-effects) on intentional binding, using stable and natural action-effect associations. Touch-typists performed keypresses on a keyboard which were followed by either congruent (corresponding letter) or incongruent (non-corresponding letter) action-effects after different intervals. Participants estimated the interval between their keypresses and the effects. Results showed intentional binding with congruent action-effects in the beginning of the task, indicating that motor identity prediction contributes to intentional binding. However, this effect disappeared over time and at the end of the task intentional binding was observed with

incongruent action-effects. This suggests that participants adjusted their expectations regarding the action-effect's identity, due to frequent occurrence of incongruent action-effects. Further, no differences between congruent and incongruent conditions were observed at short action-effect intervals. As letters are expected to appear immediately in typing, participants' predicted timing most likely matched the actual timing of the action effect. Temporal prediction may have a stronger influence than motor identity prediction. In conclusion, motor identity prediction, assessed using naturalistic action-effect associations, influences intentional binding, at least when temporal predictions are violated. Further, despite stable associations participants can easily adjust their predictions regarding the action-effect's identity, which may inhibit previous associations of action effects.

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(103)

### **The Influence of Distractor Rhythms on Rhythm Discrimination within and between Sensory Modalities.**

DANIEL BRATZKE, ROLF ULRICH, *University of Tübingen.*

The encoding of visual rhythms can be strongly disrupted by concurrent auditory distractor information. Based on this observation, Guttman et al. (2005) concluded that visual rhythms are obligatory and automatically encoded in the auditory domain (i.e., cross-modal encoding). In a series of experiments, we investigated the influence of incongruent distractor information on rhythm discrimination. Both, distractor rhythms and target rhythms could be either visual or auditory, and the distractor rhythms were presented either during the encoding or during the retention of the target rhythms. Catch trials were included to control for the possibility that participants simply ignore the distractor information. In all experiments, auditory distractors impaired discrimination performance at least as strongly as visual distractors, irrespective of whether the target rhythms were visual or auditory. Even though this result pattern is consistent with the notion of cross-modal encoding, its interpretation is complicated by the fact that discrimination performance was generally better for auditory than for visual target rhythms. Thus, it is possible that the auditory distractor rhythms were more effective than the visual ones because the auditory system is more sensitive to temporal information than the visual system.

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(104)

### **Sounds Enhance Low-Contrast Letter Identification.**

MARIA DOLORES DE LA ROSA GAMIZ, KARIN MARIA BAUSENHART, *University of Tübingen.*

Several studies show that perceived visual duration is strongly affected by concurrently presented auditory intervals with congruent and incongruent durations. It has been suggested that this effect depends on early perceptual processes by which auditory duration alters the duration of the visual internal representation. To investigate this hypothesis more directly, in Experiment 1 we asked participants to identify backwards-masked letters presented unimodally or accompanied by shorter-, same-, or longer-duration sounds. Interstimulus interval (ISI) between letter and mask varied randomly from trial to trial. If multimodal integration depends on early perceptual mechanisms, the presence of any sound should enhance masked letter identification compared to the unimodal

presentation. Moreover, longer and shorter sounds should enhance and impair masked letter identification, respectively. In contrast to these hypotheses, the results showed no auditory enhancement of letter identification performance. However, previous evidence suggests that sounds may modulate visual contrast detection sensitivity specifically for low contrast targets. Therefore, in Experiment 2 we examined the effect of same and conflicting auditory durations on the identification of low-contrast letters. The results showed that the presence of any sound, independently of its duration, enhanced identification of low-contrast letters. Therefore, these results suggest that the duration of the visual target internal representation is not altered by sound duration. Taken together, however, concurrent sounds seem to boost perceptual low-level processes, resulting in increased contrast sensitivity, rather than enhancing higher-level processes as complex feature binding and identification. Email: [Maria Dolores de la Rosa Gamiz, maria-dolores.de-la-rosa-gamiz@uni-tuebingen.de](mailto:Maria Dolores de la Rosa Gamiz, maria-dolores.de-la-rosa-gamiz@uni-tuebingen.de)

(105)

### Audiovisual crossmodality in Childhood.

IRUNE FERNÁNDEZ- PRIETO, *Fundació Sant Joan de Déu, Parc Sanitari Sant Joan de Déu & Universitat de Barcelona*, JORDI NAVARRA, *Fundació Sant Joan de Déu, Parc Sanitari & CIBERSAM*, FERRAN PONS, *Universitat de Barcelona*.

Crossmodal correspondences between acoustic pitch and spatial features (e.g., height) have been demonstrated extensively in adults. High- and low-pitched sounds tend to be mapped into vertical coordinates, up and down, respectively. We have hypothesized that this pitch-height link may be influenced by the development, during childhood, of spatial and linguistic abilities. In order to address this question, seventy children between 9 to 12 years old, divided in 3 groups (4th, 5th and 6th grade of primary school), completed a modification of Rusconi and colleagues' study (2006) to evaluate the perceptual correspondence between pure tones and height. Furthermore, we analysed the correlation between the students' performance in an auditory task with other spatial and linguistic measures. The participants' auditory pitch performance was measured in a frequency discrimination test. The participants also completed 3 tests of the Wechsler Intelligence Scale for Children IV (WISC-IV): (1) Vocabulary, to assess verbal intelligence, (2) Matrix reasoning, to measure visuospatial reasoning and (3) Blocks design, to analyse visuospatial/motor skills. The results revealed significant crossmodal effects between pitch and height in all the groups. Interestingly, only the older group (11-12 years old) showed a positive significant correlation between performance in visuospatial/motor tasks and the pitch discrimination auditory test. In contrast, no correlation was observed between this test and the vocabulary test. These findings may indicate crossmodal correspondences between pitch and height in childhood, and also that this effect may be modulated by developmental factors that are present between the age of 9 and 12 years old.

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(106)

### Perspective Taking – The Social and Cognitive Consequences of Rotating the Perspective.

ALICJA GNIEWEK, HANNA SZUSTER-KOWALEWICZ, AGNIESZKA WOJNAROWSKA, *University of Warsaw*.

The aim of the research was to analyse the phenomenon of perspective taking – especially the ability to rotate the perspective spatially. While concentration on the self is ongoing and automatic, assuming the perspective of others is volitional, conscious and reflective (Kahneman, 2013). Hundreds of studies have confirmed that perspective taking (construed as situational strategy or individual disposition) significantly improves the quality of social functioning. (Batson, 1991; Hoffman, 2000, Galinsky, Moskowitz, 2000). However, little is known of the cognitive mechanisms that regulate this ability.

The presented research focused on the performance of the participants in a task that required changing the perspective. Inspired by Epley's (2004) and Keysar's (2000) methods, a computer application "Bookcase" was developed. A participant, seated in front of a bookcase, had to arrange the objects, according to the instructions given by a person sitting opposite to him (experimental conditions) or next to him (control group). We measured also dispositional tendency for perspective taking and the infra-humanization.

The main results show that participants who needed to rotate the perspective in the experimental group performed the task worse than those in control group. It confirms the magnitude of the egocentric bias – even upon a direct instruction, one has difficulty abandoning their own perspective and focusing on others. Moreover, in experimental conditions participants saw others as experiencing fewer secondary emotions than those in control group. It suggests that perspective taking is an overloading task, requiring cognitive resources, which in the end may result in more schematic and narrow social perception.

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(107)

### Physical and Mental Effort Reduces Implicit Sense of Agency.

EMMA HOWARD, ANDREW P BAYLISS. *University of East Anglia*.

Here we investigated the role of effort for agency ascription for actions performed under varying levels of physical or cognitive load. We implemented an interval reproduction paradigm, in which participants estimate the temporal interval between two events. Participants underestimate the delay between two events where the first is an action they execute - 'intentional binding'. Our participants reproduced the delay between their pressing a key and a tone sounding (agentic/active), compared with judging the delay between two tones (non-agentic/passive). Participants concurrently pulled sports resistance bands at high and low resistance levels, and other participants performed a working memory task with high and low load levels. We found that temporal binding in agentic conditions was greater under low compared to high mental or physical effort. These findings suggest that the action monitoring system allocates less resources to 'binding' agentic cause and effect when it is under strain – an effect common to physical or mental effort. Email: Emma Howard, [Emma.Howard@uea.ac.uk](mailto:Emma.Howard@uea.ac.uk)



(108)

### **The Motor Resonance Driven By Reach-To-Grasp Is Not Shaped By Physical Similarity But By “Vitality Form”.**

BARBARA F. M. MARINO, PAOLA RICCIARDELLI, *University of Milano-Bicocca/Milan Center for Neuroscience.*

Growing empirical evidence shows that the mirror neuron motor resonance, which is thought to be a crucial mechanism for social understanding, is modulated by the motor similarity between the observer and the observed agent. Here we investigated whether also their physical similarity can exert a modulatory effect. Twenty-four young adults had to categorize manipulable objects (graspable using a power or a precision grip) and non-manipulable objects into natural or man-made things, immediately after having watched 2-s long video-clips of hands performing power and precision grip movements. Young adult, child and elderly hands were used. We found that reach-to-grasp movements primed object categorization. More interestingly, categorization was a function of hand age and grip. Specifically, faster RTs in the categorization task were found in trials where precision grip movements were performed by elderly hands and power grip movements were performed by young adult hands. This pattern of results clearly indicates a lack of an own-age effect and suggests instead an effect of the “vitality form” (the cognitive/affective style of an action) of the reach-to-grasp movements, which systematically changed with hand age. This was confirmed by a kinematic analysis indicating that elderly hands performed precision grip movements more accurately, while young adult hands performed power grip movements more skillfully, in agreement with the RTs pattern of results. Therefore, we brought preliminary evidence that the motor resonance driven by reach-to-grasp is not shaped by physical similarity but rather by the vitality form of the action.

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increasing action-effect intervals. Thus, variations of action-effect intervals seem to address postdictive IB processes. Moreover, the influence of interval duration on IB is more complex than previous research suggested. For ranges of short intervals, IB increases with interval duration, while for long ranges it decreases.

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(109)

### **The Influence of Short Action-Effect Interval Durations on Intentional Binding.**

MIRIAM RUESS, ROLAND THOMASCHKE, ANDREA KIESEL, *Albert-Ludwigs-Universität Freiburg.*

Environmental stimuli caused by actions (i.e., effects) are perceived as being earlier compared to stimuli not caused by actions. This phenomenon is commonly referred to as intentional binding (IB). Previous studies have investigated the influence of action-effect interval duration on IB-magnitude and observed that IB decreases with increasing duration. However, previous studies applied relatively long duration ranges, rather atypical for real life effect-delays. We tested how IB magnitude behaves in a range of short action-effect intervals, more comparable to real life effect delays. Additionally, action-effect intervals varied predictably between blocks or randomly within blocks. While participants watched a fast moving clock, a sound stimulus was presented. They had to report at which position the clock hand was when they perceived the sound. In one condition the sound was presented alone (baseline), while in another condition, participants caused the sound by a key press (experiment). We measured IB as the difference between the baseline and experimental condition. Within subjects we manipulated whether the three intervals (200, 250, 300 ms) varied between blocks (predictable) or randomly within blocks (unpredictable). For both, predictable and unpredictable intervals, we observed consistently larger IB magnitudes with

CENTRAL HALL,  
SUNDAY 8TH MAY, 10:00-12:40  
POSTER SESSION IV

### Attention and Performance

(01)

#### Predicting High Levels of Multitasking Reduces Between-Task Interactions.

RICO FISCHER, *University of Greifswald*, GESINE DREISBACH, *University of Regensburg*.

The simultaneous handling of two tasks requires shielding of the prioritized primary task (T1) from interference caused by the secondary task (T2) processing. Such interactions between tasks (e.g., between-task interference, or crosstalk) depend on the similarity of both tasks and are especially pronounced when both tasks overlap strongly in time. In the present study we investigated whether between-task interference can be reduced when specific items do not predict the level of interference but instead, the degree of temporal proximity between both tasks. We implemented an item-specific proportion manipulation of temporal task overlap (SOA). Selected stimuli of T1 predicted high temporal task overlap (short SOAs) in 80% of trials whereas other stimuli of T1 predicted low temporal task overlap (long SOAs) in 80% of trials. Results showed that the predictive value of T1 stimuli determined the adjustment of T1 shielding. That is, interference from the secondary task was significantly reduced for items predicting high temporal task overlap compared to items predicting low temporal task overlap. Importantly, task shielding was not initiated by predicting the actual conflict level (i.e., whether T1 and T2 required compatible/incompatible responses) between tasks but by specific items predicting conditions in which two tasks are likely to interact (i.e., short versus long SOA). These findings offer new insights into the specificity of contextual bottom-up regulations of cognitive control. Email: Rico Fischer, [rico.fischer@uni-greifswald.de](mailto:rico.fischer@uni-greifswald.de)

(02)

#### Assessing Stimulus-stimulus (semantic) Conflict in the Stroop Task Using Saccadic Two-to-one Color Response Mapping and Pre-response Pupillary Measures.

NABIL HASSHIM, BENJAMIN A PARRIS, *Bournemouth University*.

Conflict in the Stroop task is thought to come from various stages of processing including semantics. Two-to-one response mapping where two response set colors share a common response location has been used to isolate Stimulus-Stimulus (semantic) from Stimulus-Response conflict in the Stroop task. However, the use of congruent trials as a baseline means that the measured effects could be exaggerated by facilitation and recent research using neutral non-color word trials as a baseline has supported this notion. The present study sought to provide evidence for Stimulus-Stimulus conflict using an oculomotor Stroop task and early pre-response pupillometric measure of effort. The results provide strong (Bayesian) evidence for no statistical difference between two-to-one response mapping trials and neutral trials in both saccadic response latencies and pre-response pupillometric measures, supporting the

notion that the difference between same-response and congruent trials index facilitation in congruent trials and not Stimulus-Stimulus conflict and providing evidence against the presence of semantic conflict in the Stroop task. We also demonstrate the utility of pre-response pupillometry in measuring Stroop interference supporting the idea that pupillary effects are not simply a residue of making a response.

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(03)

#### Executive Function, Social Cognition and Prejudice in Children.

ÁNGELA VICTORIA HOYO RAMIRO, CHARO RUEDA CUERVA, ROSA MARÍA RODRÍGUEZ-BAILÓN, *University of Granada*.

Introduction: previous research with children indicates that there is a relationship between Executive Function (EF) and Theory of Mind (ToM), as well as between EF and Perspective-Taking (PT) skills. Moreover, a link between PT and prejudice has been found. The EF considerably develops between the age of 4 and 7 years, and promotes the development of ToM and TP skills. : At this age, the expression of prejudice reaches a peak, that decreases in late childhood. The goal of this study was to analyze the relationship between EF, ToM, PT, and prejudice. We expect a positive relation between EF and social cognition skills (ToM and TP), and a negative relation between EF skills and prejudice. We also predict a negative relation between social cognition and prejudice. Method: 95 children, divided into two age groups (5-6 years old,  $N=52$ ,  $M=69,6$  months; 8-9 years old,  $N=43$ ,  $M=107,1$  months), participated in the study. There were two assessment sessions: in the first one we evaluated the EF, ToM and intelligence. In the second session children completed the TP and prejudice tasks. Results: we found a significant and positive relation between EF and social cognition skills (ToM and PT), and a significant and negative relation between EF and prejudice. Conclusions: EF seems to have important relationships with social cognition as well as prejudice processes.

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(04)

#### Eyes Tell You What to Do: Observed Gaze Direction Strengthens Egalitarianism.

TOKIKA KURITA, *Mie University*, SHOTA UONO, *Kyoto University*.

We investigated whether others' attention to objects associated with egalitarianism strengthens the observer's egalitarian orientation. Sixty-four students were randomly assigned either an experimental or a control condition. One-half of the participants observed others' gaze-directions toward words related with egalitarianism, in a gaze-cueing task. The other half of the participants observed others' gaze-direction away from such words. Following the gaze-cueing task, explicit and implicit egalitarianism were measured using the





Social Dominance Orientation Questionnaire (Pratto & Sidanius, 1993) and the Implicit Association Test (Greenwald, McGhee, & Stewarts, 1998), respectively. Results showed that others' gaze-direction toward egalitarian-related words enhanced the observer's explicit egalitarianism and discouraged the observer's implicit egalitarianism. On the basis of these findings, we discuss the role of others' eye gaze in the formation of implicit and explicit egalitarian attitudes.

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#### **Executive Tests Validation: Validity, Sensibility and Reliability.**

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Introduction: Executive functions have several implications in many cognitive tasks. These functions control and regulate other cognitive process to produce adapted answer. Miyake et al. (2000) identified three executive functions: inhibition, flexibility and updating. The development of different executive tests had a crucial role in identifying and understanding these complex functions. Standard executive tests are used in cognitive neuropsychology and in clinical psychology, but habituation and learning effects could appear when the same tests are used several times (e.g. inhibition: Davidson, Zacks, & Williams, 2003, flexibility: Karbach & Kray, 2010). The validity of new tests is thus important to counteract the bias resulting from the knowledge about these tests. The objective of this study was to valid some new executive tests. To that, three criteria were examined (Cook & Beckman, 2006): the validity (normal distribution of the scores), the sensibility (correlation with standard tests) and the reliability (split-half reliability). Material and methods: Young adults (20-50 years) were submitted to three standard tests per executive functions (*inhibition*: Stroop test, Hayling and Stop-signal; *flexibility*: Trail Making Test (TMT), Local-Global, Number-letter, and *updating*: Running, Paced Auditory Serial Addition Test (PASAT), N-Back) and six new executive tests. All the new tests were divided into two parts to compare the performance to the first part with those of the second part (reliability). Results and conclusion: The new tests respect the three criteria, and could be used to assess the executive capacities of individuals. Email: Lucile Burger, [lucile.burger@etu.univ-tours.fr](mailto:lucile.burger@etu.univ-tours.fr)

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#### **Association between Aerobic Fitness and Sustained Attention: A Behavioural and Electrophysiological Approach.**

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We investigated the relationship between aerobic fitness and sustained attention in young adults. Sustained attention was measured by a 60' version of the Psychomotor Vigilance Task (PVT) in two groups of participants (25 higher-fit and 25 lower-fit). Reaction times (RTs), event-related potentials and cardiac autonomic function (i.e., phasic cardiac response) were obtained and analysed as a function of time-on-task. All participants performed an incremental cycle-ergometer test to evaluate their fitness level. The results showed faster RT in higher-fit than in lower-fit participants, but only during the first half of the task. This better performance was accompanied by larger

amplitude in the contingent negative variation potential and an enhanced cardiac orienting reflex in the same period of the task in higher-fit than in lower-fit group. Crucially, higher-fit maintained larger P3 amplitude throughout the task compared to lower-fit, who showed a reduction in the P3 magnitude over time. In conclusion, higher fitness was related to an improved autonomic functioning during task performance and neuroelectric activity suggestive of better ability to allocate attentional resources over time. Moreover, higher fitness was related to enhanced brain response preparation and cardiac orienting in the first part of the task. Taken together, the results demonstrated a positive association between aerobic fitness, sustained attention, and response preparation. Email: Antonio Luque-Casado, [antonioaluque@ugr.es](mailto:antonioaluque@ugr.es)

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#### **The Hyperactive Agency Detection Device is Not Hyperactive in Threatening Situations.**

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A hyperactive agency detection device has been hypothesized to encourage belief in supernatural agents. A fundamental assumption of this hypothesis is that ambiguous threatening situations (e.g. a dark forest) lead people to over-detect the presence of intentional agents. In six threat inducing experiments ( $N = 245$ ) we have investigated whether we could find evidential support for the hypothesis that threat-induction leads to agency over-detection. Weak threat manipulations (thought control and IAPS pictures) did not lead to increases in agency detection on a Biological Motion Detection Task. A stronger threat manipulation (horror music) led to over-detection of agents on a Biological Detection Task but not to over-attribution of intentionality on a Geometrical Figures Task. The strongest threat manipulation (virtual reality) did not lead to over-detection of agents on an Auditory Agency Detection Task. Also, we did not find that agency over-detection was related to supernatural beliefs, arguing against the hypothesized idea that agency over-detection encourages belief in supernatural agents. Email: David L. R. Maij, [d.l.r.maij@uva.nl](mailto:d.l.r.maij@uva.nl)

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#### **Cognitive Mechanisms Involved In Altering Attentional Bias: A Linear Ballistic Accumulator Model Approach.**

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Attentional bias refers to an implicit preference to attend to self-referent stimuli. Changes in mood can shift this preference toward mood-congruent stimuli. Attentional biases for negative affective information have been implicated as a maintaining factor in a number of psychological disorders. Dual process models of attention propose shifts in attentional bias are likely due to changes in the implicit preference for specific stimuli; however, the cognitive mechanisms involved are unknown. The aim of the current study was to identify the cognitive processes underlying bias change by applying the Linear Ballistic Accumulator model (LBA; Brown and Heathcote, 2008) to data collected in a mood manipulation paradigm. Undergraduate student participants ( $N=80$ ) were randomly allocated to either a negative mood induction group or a control group. Attentional bias scores were obtained pre- and post-mood induction. Changes in these scores demonstrated

that mood significantly affected bias. These data were analysed using the LBA model. Given the current theoretical understanding of shifts in bias, it was hypothesised that the specific decisional process that would be altered is implicit expectancy (start point variability). The model also examined the role of decision criterion (threshold), and rates of evidence accumulation (drift rate) in bias modification. The results offer a more concrete understanding of the decision processes involved in bias modification and have important clinical implications for attentional retraining paradigms aimed at modifying implicit cognitive processing.  
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### Bottleneck Bypassing: Finding Several Needles in a Haystack.

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Hazeltine, Ruthruff, and Remington (2006) reported substantial effects of input-output modality compatibility on the magnitude of dual-task costs. Specifically, interference was nearly eliminated after simultaneous training with one Visual-Manual task and one Auditory-Vocal task ("compatible" modalities) but remained substantial with one Visual-Vocal task and one Auditory-Manual task ("incompatible" modalities). This finding suggests that parallel central processing – bottleneck bypassing – is possible, at least with compatible modalities. Here, we reexamined this claim in four experiments manipulating modality pairings, using a PRP transfer paradigm better suited to definitively assessing bottleneck bypassing. Participants first practiced only one task (Auditory-Vocal, Auditory-Manual, Visual-Manual, or Visual-Vocal), which was later presented as Task 2 in a PRP procedure. Bottleneck bypassing was found only in many participants tested with compatible modality pairings (interference < 200 ms), but no participants tested with incompatible modality pairings (interference > 400 ms). Bottleneck bypassing is within reach under the "right" pairings, but is otherwise elusive.

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### The Influence of the Visual Surrounding Environment in Cognitive Tasks: A Study with Children.

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The study of the person-environment is crucial to fully understand human behavior, however little is known about the influence of the surrounding environment in the human cognitive performance, particularly in children. In this work we investigated the effect of a distracting environment in the performance of four cognitive tasks in children. Children performed two visuospatial attentional tasks (selective response and Go/No-Go tasks) and two memory tasks (Corsi blocks and Rey Complex Figure), both when immersed in a distracting and a non-distracting environment. In the distracting condition, distractors (e.g., pictures) were added in a platform placed in the participant's surrounding environment, whereas in the non-distracting condition no distractors were present in the same platform. Each participant performed the tasks in each of

these conditions in different sessions with an interval of 14-21 days between sessions. Order of the type of environment in each session and order in which the tasks were performed were counterbalanced across participants. Overall, the results revealed better performance when tasks were done in the non-distracting environment, as compared to when they were done in the distracting environment, particularly when attention is involved. Our data suggest the need to consider the potential damaging consequences of distracting environments when children have to perform tasks that demand their attention and memory. Specific examples of such situations are presented in the discussion.

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### Increased Picture-Word Interference in Chronic and Recreational Users of Cocaine.

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**Introduction** Language production requires that speakers effectively recruit inhibitory control to successfully produce speech. The use of cocaine is associated with impairments in cognitive control processes in the nonverbal domain, but little is known about the impact of cocaine abuse on these processes during language production. This study aims to observe the possible impairment of inhibitory control in language production among recreational and chronic cocaine polydrug users. **Material** Two experiments were carried out on chronic (experiment 1) and recreational (experiment 2) cocaine polydrug users performing a Picture-Word task, yielding an index of semantic interference. **Method** Participants were matched for sex, age, and intelligence (Raven's progressive matrices) with cocaine free controls, and their performance was compared on the Picture-Word task. **Results** Chronic and recreational users showed significantly larger semantic interference effects than cocaine-free controls, thereby indicating a deficit in the ability to inhibit interfering information. Evidence indicates a relationship between the consumption of cocaine, even at recreational levels, and the inhibitory processes that reduce the activation of the distractor's prepotent lexical representation when the target picture and the distractor are semantically related. **Conclusions** This deficit may be critical in adapting and responding to many real-life situations where an efficient self-monitoring system is necessary for the prevention of errors during speech production.

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### Self-Referentiality Modulate Attention Orienting by Gaze and Arrows.

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Eye gaze and arrows automatically trigger attention orienting. Recent studies have shown differences between gaze and arrows in attention orienting. However, the mechanisms underlying these differences remain unknown. One such candidate mechanisms is self-referential processing. To investigate this possibility, we trained participants to associate two cues (a red and green arrow in Experiment 1A and two faces in Experiment 1B) with distinct words ("self" and "other"). Following the training task, the cueing task



was conducted. Self- and other-referential arrow (Experiment 1A) and gaze cues (Experiment 1B) were presented, and participants were asked to localize auditory targets following the cue stimulus as quickly and accurately as possible. We used voice and tone as targets to investigate whether the cueing effect to self- and other-referential cues differs in a manner similar to that reported for gaze and arrows. Although a previous study demonstrated an enhanced cueing effect to the voice versus tone target in gaze but not arrow cues, we found that self-, but not other-, referential cues induced the enhanced cueing effect to the voice target regardless of the cue characteristic (i.e. gaze or arrows). The results suggest that the difference between gaze and arrows in orienting attention can be partially explained by the self-referentiality of gaze. Furthermore, in Experiment 2, we found a reverse pattern of cueing effect between gaze and arrows by training participants to associate arrows with “self” and gaze with “other”. The results suggest that differences in the self-referentiality of gaze and arrow cues are not inherent. Email: Shota Uono, [uonoshota1982@gmail.com](mailto:uonoshota1982@gmail.com)

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### **Auditory Prospective Memory: Exogenous vs. Endogenous Attention Modulated by the Perceptual Salience of the PM Cue.**

ENRICO VARRIALE, ALESSANDRA CAPUOZZO, MARIA A. BRANDIMONTE, *Suor Orsola Benincasa University, Naples.*

PM involves the process of forming an intention and then realizing the intention at some appropriate time in the future. According to the Multiprocess View (Einstein & McDaniel, 2000), PM retrieval could be based either on a strategic process of continuous environment monitoring via attention-demanding mechanisms, or through a relatively spontaneous process by which, for example, perceptually salient targets involuntarily and spontaneously capture attention. In contrast, the Preparatory Attention Model (Smith et al., 2007) holds that salience does not guarantee detection and that PM activation -independent of stimulus type- will always engage attention. Accordingly, there should be an attentional cost even for highly salient targets. In the present study, a novel, fine-grained perceptual PM auditory task was used, in which the frequency of the prospective-cue tones (perceptual salience) was 650 Hz (high), 575 Hz (medium) and 525 Hz (low), while the frequency of the OT tones was 500Hz. One hundred thirteen participants were assigned to one of four conditions: (1) Ongoing Task only (OTo), (2) High-salience PM cue; 3) Medium-salience PM cue; and Low-salience PM cue. Results showed that PM-cue salience affected OT RTs (i.e., the less salient the PM cue, the higher OT RTs). Most important, when the salience of PM cues was maximized, no RT costs emerged in the OT performance. These results favour the Multiprocess View by showing that exogenous and endogenous attention mechanisms can be modulated, within the same paradigm, by the perceptual salience of the stimulus.

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### **Emotional Regulation and Cognitive Control Interactions.**

MARÍA A. LEYVA, JOAQUÍN M. M. VAQUERO, JOSÉ LUIS MATA, ALBERTO ACOSTA, MARÍA J. FUNES, *University of Granada, Mind, Brain and Behavior Research Center Granada.* Many everyday situations require both emotional and cognitive

regulation strategies; however most research has studied these two processes in isolation. The aim of the present study is the study of the behavioral and psychophysiological interactions that might arise among these two processes when they are jointly required within the same task. To test that, we measured whether the employment of emotional response suppression modulates performance on a subsequent cognitive control (Simon) task, with both control requirements taking place sequentially and within the context of the same trial. Furthermore, we were interested to test whether variables like trait anxiety, emotional valence, and the temporal overlap among the two regulation requirements modulate the relationship among them. The results show that most behavioral interactions were found at the shortest stimulus onset asynchrony, and were modulated by trait anxiety and emotional valence. The pattern of results will be discussed in terms of recent models of common brain mechanisms responsible of emotional and cognitive control.

**Keywords:** Emotion regulation, Cognitive Control, Suppression, Anxiety

### **Complex Cognition**

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### **Determinants of Environmental Risk Perception in Adolescents.**

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The current study is part of a LIFE+ Environment Policy and Governance research project (GIOCONDA), which aims at involving the youth in the construction of effective evidence-informed policies on environment and health. One of its major priorities is to understand young people's perception of risk associated to environmental pollutants and how it is affected by demographic variables and by perceived pollution. In order to achieve this purpose a population-based questionnaire study was conducted on a sample of 500 Italian students, aged 9-16 years, from four Italian areas identified by different environmental conditions (high or low pollution). The questionnaire on risk perception comprised 11 rating scales, modeled on the psychometric paradigm, assessing several important qualitative characteristics of the risks associated with environmental pollutants (e.g., knowledge of consequences, severity of consequences). Two further questions were also included, assessing perceived pollution and concern about pollution at school.

Factorial analyses revealed two principal components, labeled *risk perception* and *risk acceptance*.

Results showed that the *risk perception scale* significantly correlates with the two questions about air pollution at school. Younger students presented lower scores on the *risk perception scale* than older students, probably because their “ecological consciousness” is not fully developed yet. Finally, participants from the city of Taranto (notorious for a steel refinery) showed higher scores than participants from other cities (Ravenna, Arno, and Naples).

These findings highlight distinct patterns of risk perception depending of age and place of living. Their implication for theories of risk perception will be discussed.

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### Pseudocontingencies and Cue Competition: Effects of Pairwise Correlations of Options and Outcomes with Context on Choice Behavior.

HANNA FLEIG, THORSTEN MEISER, *University of Mannheim*. A pseudocontingency is a potentially biased estimate of the contingency between two variables  $X$  and  $Y$  which is inferred from jointly skewed base rates of  $X$  and  $Y$ , or from pairwise correlations of  $X$  and  $Y$  with a context variable  $C$ . Research on pseudocontingencies on the one hand and on cue competition on the other hand demonstrates that  $CX$  and  $CY$  contingencies can encourage or impede the inference of a contingency between  $X$  and  $Y$ . We investigated under which circumstances learners treat pairwise correlations of  $X$  and  $Y$  with  $C$  as evidence for or against an  $XY$  contingency. In Experiments 1 and 2, we manipulated the strength of  $CX$  and  $CY$  contingencies in a learning sample of joint observations of  $C$ ,  $X$ , and  $Y$ . In Experiment 3, the learners' sensitivity to the  $CX$  or the  $CY$  contingency was varied. Our results indicate that participants inferred a pseudocontingency between  $X$  and  $Y$ , the sign of which matched the signs of  $CX$  and  $CY$  contingencies in the learning sample, despite a true  $XY$  contingency of the opposite sign. Pseudocontingencies were reflected even in decision behavior with immediate and personally relevant consequences. The strength of the contingency perceived between  $X$  and  $Y$  depended on the (objective or subjective) strength of the  $CX$  contingency, though. Instead of cue competition effects at the expense of  $X$ , we observed potentiation of  $X$  at the expense of  $C$  if  $C$  and  $X$  were perfectly redundant predictors of  $Y$  in a blocking or an overshadowing design. Email: Hanna Fleig, [h.fleig@uni-mannheim.de](mailto:h.fleig@uni-mannheim.de)

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### Can Induced Analytic Thinking Lead To More Utilitarian Choices? Effects of Cognitive Reflection and Disfluent Processing On Moral Decision-Making.

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Previous research suggests that utilitarian decisions can be affected by reflective ability, which is shown by the reported relationship between higher scores on the Cognitive Reflection Test (CRT; Frederick, 2005) and utilitarian decisions (Paxton, Ungar, & Greene, 2012). Additionally, experiments presenting items written in a disfluent font found a better performance on CRT (Alter, Oppenheimer, Epley, & Eyre, 2007). Taking these results into account, the two studies presented here tested cognitive reflection and perceptual fluency's effects on moral decision-making. In Experiment 1, we compared responses to moral dilemmas of participants assigned to different groups after they have responded to either the CRT or a control task (Berlin Numeracy Test, BNT), having or not feedback over their performance. The underlying assumption was that CRT, but not BNT, would induce cognitive reflection, especially after having received feedback. In Experiment 2, participants responded to personal and impersonal moral dilemmas written in both fluent and disfluent fonts in different blocks (order counterbalanced). Experiment 1 found that participants in the feedback condition who scored higher on the CRT made more utilitarian decisions compared to those that scored low after feedback. Experiment 2 showed that disfluency increased utilitarian responses, both in personal as well as in impersonal

dilemmas. Together these findings suggest that moral decisions may not only be affected by individual thinking dispositions, but that analytic thinking may be also induced by increasing cognitive reflection and processing disfluency, leading to more utilitarian decisions.

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### Can Eyewitness Facial Expressions Predict Lineup Accuracy?

MARC W. PATRY, CHRISTINA J. CONNORS, VICTORIA PATTERSON, NICOLE MALLAY, JESSICA CAMPBELL, and STEVEN M. SMITH, *Saint Mary's University Halifax*.

Decades of research in social-cognitive psychology has shown clear, consistent problems with human memory, and eyewitness memory specifically. Research shows that eyewitness testimony is weighted heavily in legal decision making that self-reported eyewitness confidence is at best a very weak indicator of identification accuracy, and that eyewitness confidence tends to be viewed as an indicator of accuracy. There is a long and distinguished tradition of basic and applied theory and research on human emotions, and facial expressions of emotion. Subtle emotional reactions, which may be so brief as to escape conscious awareness, may register on the human face. Further, pre-emotional appraisals of an event can cause cognitive activity that may register automatically and involuntarily in the face. It is clear that 1) facial expressions can happen very quickly, and 2) facial expressions may occur involuntarily, outside of an individual's cognitive awareness. Thus, it is reasonable to hypothesize that a fleeting cognitive appraisal or reaction to the image of a criminal perpetrator, when present in a lineup, might cause an involuntary facial action. Two studies examined the general hypothesis that witness facial expressions would differentiate between accurate and misidentifications (Study 1  $N = 133$ , Study 2  $N = 127$ ). Undergraduate student participants viewed a series of simulated mock crimes followed by sequential lineups. Eyewitness facial expressions were videotaped, and later coded by blind coders certified in the Facial Action Coding System. Preliminary data analysis does not show support for the hypothesized relationship between eyewitness facial expressions and lineup identification accuracy. Email: Marc Patry, [marc.patry@smu.ca](mailto:marc.patry@smu.ca)

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### Connectivity from Insula and Ventrolateral Prefrontal Cortex Predicts Contingency Learning Anomalies in Pathological Gamblers.

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Background. Gamblers display abnormal outcome expectancies and misperceive cue-outcome relationships. The insula plays a role in these distortions (Clark et al., 2014), and mediates anticipation of monetary outcomes (Tsumumi et al., 2014). Complementarily, the neighbor ventrolateral prefrontal cortex (vlPFC) mediates conditioned reactivity to gambling cues (Goudriaan et al., 2010). — Aims. (1) To check for differences between pathological gamblers (PG) and healthy controls (HC) in performance in a contingency learning task, and in resting-state connectivity from vlPFC and insula. (2) To explore (in PGs) correlations between outcome expectancy and connectivity involving these areas.

— Methods. 25 gamblers and 23 controls performed a standard contingency learning task. Separately, resting-state functional





connectivity was recorded, and bilateral seeds at vIPFC and insula were isolated for analysis. — Results. Gamblers showed increased connectivity (1) between the right insula and right middle frontal gyrus, middle temporal gyrus, and the rest of the insula; and (2) between the right vIPFC and right inferior frontal gyrus and right thalamus. Gamblers' outcome expectancy positively correlated with connectivity (1) between the left insula and the frontal pole, right inferior frontal gyrus, left superior temporal gyrus, and left precuneus; (2) between the right insula and the right occipito-parietal junction; and (2) between the right vIPFC and the left inferior frontal gyrus. — Conclusion. Our results confirm the existence of contingency learning anomalies in gamblers, and demonstrate the key role of the insula-vIPFC complex in them, particularly in connection with ventral parts of the prefrontal cortex known to be involved in feedback-driven learning and decision making.

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### Complex Screening Decisions: Evidence-based or Emotion-based Decision Making?

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Contrary to people's intuitions, many screenings have both benefits and harms. For example, cancer screening like mammography can reduce mortality but result in many unnecessary surgeries. In such cases statistical information is often provided to ensure informed, evidence-based decision making. However, few theoretical models have addressed the role of comprehension of such information in screening decisions. In three experiments (N=958), we studied how cognitive abilities (numeracy and science literacy), emotions, and a priori beliefs affect comprehension of screening statistics and decisions about screening. Improved comprehension was associated with 1) superior decision making (e.g., fewer intentions to participate in screening when it offered no benefit) and 2) more desire to participate in decision making. Path analysis showed that higher numeracy and science literacy independently predicted better comprehension and decisions. Emotions had both beneficial and detrimental effects on comprehension and decisions. Positive beliefs about screening were associated with stronger intentions to get screened, regardless of the evidence of screening effectiveness. Perceived benefits were more predictive of intentions than perceived harms. These results suggest that risk literacy and emotions (e.g., a healthy dose of fear) can promote informed decision making. At the same time emotions and beliefs resulting from persuasive campaigns can have strong effects on screening intentions beyond the available evidence.

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### Giving vs. Losing: Age Differences in Decisions about Charitable Donations.

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In addition to making decisions about gains and losses that affect only ourselves, often in life we make decisions that benefit others (e.g., charitable donations). Research on lifespan changes in motivational orientation suggests that altruistic motives become stronger with age. However, few prior studies have explored the

effect of age on decisions that affect others. The current study used a realistic financial decision making task involving choices for a) gains, b) losses, and c) charitable donations. Each decision involved an intertemporal choice, in which the participant was required to select either a smaller-sooner or a larger-later option (e.g., \$5 now or \$7 in 30 days?) that could affect their bonus payout. Participants included 36 healthy younger adults (mean age: 25.1 years) and 36 healthy older adults (mean age: 70.4 years). Both age groups chose more larger-later donations than larger-later losses, but the magnitude of this effect was amplified in older relative to younger adults. The age difference in intertemporal choices for charitable donations was not accounted for by socioeconomic differences. These findings suggest that intertemporal choices may be sensitive to an age-related increase in altruistic motivation. We discuss implications for theories of intertemporal choice and aging, as well as potential applications in the area of philanthropy and charitable giving.

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### Independence of Irrelevant Alternatives in Decisions from Experience: A Challenge for Reinforcement Learning Models.

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Normative decision theory assumes *independence of irrelevant alternatives* (IIA), stating that the relative preference of two options is independent of the choice set they are presented in. Previous research demonstrated systematic violations in decisions from description, yet it remains unclear whether IIA is violated in decisions in which the properties of the options have to be learned by trial-and-error. Such decisions are usually analyzed within the framework of reinforcement learning, within which existing models do not predict violations of IIA. The *similarity effect* was explored in a repeated-play-game paradigm with full feedback. Twenty-four participants (15 female) completed a training block consisting of two options and two counterbalanced experimental blocks consisting of three options each. The experimental blocks shared two out of three options (a risky, high magnitude option and a safe, low magnitude option) with the third being a similarity decoy, in each block for a different option (i.e., in one block risky, high magnitude and in the other one safe, low magnitude). In line with the similarity effect, participants' behavior systematically violated IIA. The relative choice proportion of the dissimilar target option differed significantly between the two experimental blocks,  $t(23) = 3.70, p < .01, d_z = 0.76$ . We developed a novel *accentuation of differences* model, that focuses attention on distinct outcomes and outperformed other reinforcement learning models in terms of one-step-ahead predictions and simulation performance. The present experiment demonstrates systematic violations of IIA in decisions from experience and offers a psychologically motivated model to explain this violation.

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### The Role of Statistical Learning in a Probabilistic Gambling Task: Strategies and the Beginner's Luck.

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In our daily life, we experience continuous fluctuations in risk, to which we have to adapt. The sequential processing of risky choices evokes expectations about outcome contingencies. This mechanism could also involve some aspects of statistical learning, but so far no studies have tested this association. Therefore, in a population-based sample of adults ( $N = 180$ ), here we aimed to investigate the role of statistical learning in strategical adaptation in the Balloon Analogue Risk Task (BART). Statistical learning was measured by the Alternating Serial Reaction Time (ASRT) task. We identified four strategical clusters based on behavioral markers of the BART: (1) moderate/average risk taking, (2) slow processing, (3) risk-averse, and (4) risk-taker strategies. Importantly, the latter two subgroups with distinctive risk-taking profile showed higher statistical learning in the ASRT task than participants with average risk taking. Moreover, the first five experienced outcomes in the BART generally predicted participants' risky choices later in the task: Early unlucky outcomes led to lower exploration and lower risk-taking behavior. This association was most pronounced in the risk-averse subgroup. Based on the findings we propose that sensitivity to probabilities in our environment contributes to forming strong risk-taking attitudes, however, this contribution can be altered by the initial experience. Our results also highlight the role of statistical learning in gambling habits, which could further contribute to better understand maladaptive risk-taking behavior.

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### Process Models of Cue- and Exemplar Based Decision Making: A Drift Diffusion Approach.

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People can use several strategies to make good decisions, but which strategy is optimal depends on the context (Karlsson et al., 2008). Formal modeling approaches have been used to determine the conditions under which people rely on which strategy. Cue abstraction models (CAM) propose that people make decisions about objects by linearly integrating learned cue weights predictive of a criterion (Juslin et al., 2003). Exemplar based models (EBM) suggest that people make such decisions based on the similarity to learned exemplars (Nosofsky & Palmeri, 1997). Both model classes fit choice responses well, but a principled unitary approach for comparing CAM and EBM based on both choice and RT data has not been proposed. This is surprising in light of the fact that both model classes implicitly assume that some form of evidence accumulation underlies the decision process. We demonstrate how drift diffusion models of evidence accumulation can be integrated with CAM and EBM to accommodate choice and RT. This approach explicates the evidence accumulation mechanism underlying decisions, resulting in dynamic process models of cognition. The approach also puts more stringent constraints on experimental studies of strategy classification, allowing us to more confidently classify people as relying predominantly on cues or exemplars in

their decision process. The implications for our understanding of the dynamics of decision making strategies are discussed.

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### Incorporating Descriptions into Decisions from Experience.

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Decisions in everyday life are commonly made using a combination of descriptive and experiential information. However, decision-making research has mostly focused on description-only or experience-only tasks. Our aim was to shed additional light on how individuals combine information acquired by description and by experience when they are exposed to both simultaneously. We show that individuals exposed to a combination of description and experience are influenced by both sources of information, and that the influence of experience dominated the influence of description. However, the influence of descriptions does not disappear completely and was still observable even after many trials. The influence of descriptions was also highest when they were available from the first trial. Any little experience prior to the appearance of descriptions significantly reduced their influence, and more experience had no additional significant impact, which can be linked to individuals relying on very small samples. Our behavioral findings were supported by cognitive models that integrate experience with descriptions, with different weights given to each source of information. Contrary to previous research, models that included the descriptive information fitted the human data more accurately than models that did not. Descriptions, such as warning labels, should be provided very early if they are to sway behavior and that little experience is required to undermine the influence of warnings. This stream of research has important implications in understanding decision-making biases in real world settings and in creating warning labels that are effective in having desired influences on behavior.

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### The Inner Peculiarity and Difficulties in Changing the First Choice at Two-stage Decision Making (2).

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The purpose of this study is to clarify the factors that make things more difficult for modifying the wrong decisions by intuition under the two stage decision making problem. We have assumed that selectors have the high and the low state of anxieties as an important factor, and obtained the result that people who have the high state of anxiety need little feedback to modify their actions. Under the normal experiment, the subjects are given the three face-down cards, two of which are joker and the other one is ace, and they are required to choose the ace. The experiment is iterated sixty times, and the subjects learn that they have the higher probability of choosing the ace card in the second choice than in the first choice (EXPA). In the meanwhile, we have set up the experiment with two ace cards and one joker, in which case the subjects can have higher probability of choosing ace card if they do not change



their decisions in the second choice (EXPB). Comparing these situations, we have examined the relationships of the choices of the subjects with high state of anxiety and low state of anxiety. It was statistically significant that the number of switch of the subjects under the condition EXPB was less than those under the condition EXPA. We might be able to claim that, under the condition EXPB, among the subjects LG who are not likely to change their decision learn faster than HG.

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### Domain-Specific Cognition

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#### The Creative Person: An Individual Differences Approach to Creativity.

DAVID BRIDGES, HALINE E. SCHENDAN, ALISON M. BACON, MATHEW EMMETT, GIORGIO GANIS, *Plymouth University*, RUPERT NOAD, *Plymouth Hospitals NHS Trust*. What are the qualities of creative people? Convergent evidence from empirical studies and meta-analyses have indicated that the creative person is more open to new experiences, introverted, impulsive and higher in spatial intelligence, compared with less creative individuals. For example, spatial ability uniquely shapes development of creative technical innovation beyond general intelligence. Visual artists and architects score high on spatial ability, and about a third of them have dyslexia, which has been associated with exceptional spatial ability and creativity. Creative people may also differ at a fundamental level in terms of temperament. For example, creative people also display higher sensitivity to one's own internal affective states. Only a few empirical studies have examined individual differences in spatial ability, temperament or personality and how these predict creativity, and none used recent state-of-the-art assessments of temperament. The present work aims to address this gap in understanding individual differences in creativity. In this study, a battery of state-of-the-art tests of temperament, personality, spatial cognition, intelligence, and creativity were administered in the lab to a sample of normal healthy people ( $n=44$ ). Results revealed that factors in the adult temperament questionnaire, including sensitivity, predicted creativity. Furthermore, the effect of temperament on creative achievement and creative ideation varied as a function of personality. Results also indicated that spatial performance was associated with creativity. Findings indicate that creative people tend to be higher in spatial ability or have particular types of temperament and personalities.

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#### How Typists Talk to Their Fingers: Evidence for Word-Level Verbal Control of Skilled Action Sequencing.

NICHOLAUS BROSOWSKY, *The Graduate Center of the City University of New York*, LAWRENCE P. BEHMER JR, MATTHEW J. C. CRUMP, *Brooklyn College of the City University of New York*. Hierarchical theories of action planning in skilled domains like typing (Logan & Crump, 2011) have proposed a distinction between inner and outer loop control processes that represent higher-order planning (outer loop) processes and lower-level motor execution (inner loop) processes. Specifically, the outer loop control processes retrieve words as plans, and serves word-level representations to the inner loop, which then translates them to

individual keystrokes at the letter level. A critical implication of the dual-loop theory is that typists rely on verbal processes to control serial-ordering between finger movements. The current study tests the role of verbal processes in controlling fluent typing in three tasks manipulating verbal processing during typing. In Experiments 1 and 2, we demonstrate that typists type faster if they speak the words rather than letters. Experiments 3 and 4 show typing performance is worse under conditions where verbal processing is disrupted. In Experiment 3, typing was disrupted under several conditions of verbal suppression and in Experiment 4, under conditions of delayed auditory feedback. Taken together, these results provide supporting evidence for the dual-loop hierarchical control theory and suggest a role for verbal processes in the control of fluent typing.

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#### Over-Imitation in Autism Spectrum Disorder: Testing the Availability of Causal Information.

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INTRODUCTION: A couple of studies have evaluated the pattern of over-imitation in autism spectrum disorders (ASD) but contradictory results were reported. Over-imitation is observed in adults as well as in children and it refers to the imitation of action with high fidelity that task efficiency is reduced due to the imitation of irrelevant actions. METHODS: In the present study we replicate a two-action approach paradigm used in the study of over-imitation where we directly test the availability of causal information that could explain the disparate findings reported in the literature. RESULTS: We have found in 3 of 4 measures that are commonly used in the literature that the age-, education- and IQ- matched control participants show higher over-imitative and imitative pattern than a sample of high-functioning adults with ASD. No difference is found for the availability of causal information in neither group. DISCUSSION: We interpret these finding as a tendency of individual with ASD to excessively emulate the action even when the causality of the action cannot be perceived.

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#### Does Time Fly or Slow Down when You Are 20 Meters Above the Ground? The Role of Affective Response on Time Perception in the Practice of a High-Risk Sport.

CRISTINA CUELLO, JUDIT CASTELLÀ, ANTONI SANZ, *Universitat Autònoma de Barcelona*.

A field study was performed in a via ferrata in order to verify whether impulsive sensation seeking influences the affective response during an arousing activity (passing through a 70m long, 20m high, two-rope bridge) and if this response subsequently affects time perception. A total of 61 participants, 36 men (59%) and 25 women (41%), ranging from 15 to 59 years old, answered three questionnaires. Two of them were administered via smartphone in the field (just at the end point of the bridge -high arousing condition- and close to the end of the via ferrata -low arousing condition-); the third one was fulfilled online 12h to 72h after. Participants provided information about their affective state (arousal, valence

and dominance), with the Self-Assessment Manikin (SAM), time perception (with retrospective -both qualitative and quantitative judgements- and prospective measures -1min production task) and impulsive sensation seeking (with an online version of the ZKPQ-50CC ImpSS subscale). Results showed that an affective pattern characterized by high arousal, negative valence and high dominance (characteristics for anxiety/fear) generates an overestimation of time perception. Moreover, a general pattern on the whole sample was found, showing an overestimation in the production task that was significantly greater in the high arousing condition. On the other hand, none statistically significant relationship was found between sensation seeking and the measures of time perception. Results are discussed in terms of the emotional factors underlying time perception in an ecological environment.

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### **Hemispheric Asymmetries in Emotional Facial Expression and Perception of Emotions.**

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Lateralization of emotions has been explained with different approaches; however, it is still controversial. Firstly, right hemisphere hypothesis states that right hemisphere is more dominant than left hemisphere during both expressing and perceiving emotions. Then, researchers stated that emotions are lateralized by valence and arousal features. Motivational approach argues that emotions have positive/approach or negative/avoidance motivation. Recently, researchers categorize emotions as pre-goal (fear, anger, desire etc.) and post-goal emotions (happiness, sadness, grief etc.). The present study was aimed to investigate how emotions lateralized in the brain and which approach is more explanatory to understand hemispheric asymmetries of emotion processing. Secondly, the source of this lateralization was questioned: whether the asymmetries are in expressing emotions or in perceiving emotional facial expressions. Two experiments were conducted and participants were recruited from university students (N=110, 100 and age range= 18-30). Chimeric faces were used as stimuli. In 1<sup>st</sup> experiment, participants were required to decide which photo is more representative of the target emotion. Simultaneously eye-tracking data were recorded. The results showed that happiness and sadness are lateralized to right hemisphere whereas fear is lateralized in left hemisphere. In 2<sup>nd</sup> experiment, hemispheric presentation (150 msec) was used to detect perceiver's dominant hemispheres for discrete emotions. Participants were asked to decide in which side the target emotion was appeared. It is predicted that detection of target emotion is more rapid and accurate when it is presented on dominant side of the target emotion. These findings indicate that expression and perception of emotions co-evolved and affects each other.

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### **Performance in a Cognitive Task Affects Subsequent Unrelated Motor Performance.**

KATHRIN GAJDA, JULIAN VOIGT, JOCHEN MÜSSELER, *RWTH Aachen University*. Beside practice and informational feedback motivation proved to be an important factor of motor performance and motor learning. Especially self-efficacy was shown to improve or to hamper motor learning. Usually self-

efficacy was manipulated by enhancing autonomy-support or the feeling of competence (e.g. by giving positive normative feedback), but always in relation to the motor task. The present study was conducted to examine the influence of self-efficacy manipulated in a cognitive task on performance in a following unrelated motor task. Two groups of participants (N = 24, age range 19 – 30) had to solve either an easy or a difficult cognitive task and were afterwards asked to learn a novel motor task, i.e. throwing a dart with the non-dominant hand. The cognitive task consisted of answering either an easy general knowledge questionnaire or a difficult one. Those who went through the easy cognitive task showed higher self-efficacy and better motor performance than participants who completed the difficult cognitive task. Our results are the first that show a cross-domain influence of enhanced self-efficacy due to performance in a cognitive task, which improves throwing accuracy in a game of dart. Possible explanation approaches include considerations in relation to internal and external attentional focus, ruminating and dual-task costs and the feeling of learned helplessness.

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### **Automatic End Effects in Small Natural Numbers: Implications for Numbers' Mental Representation.**

RONIT GOLDMAN, JOSEPH TZELGOV, *Ben-Gurion University of the Negev*.

The current work examined the representation of end stimuli of numbers in long term memory (LTM). We focused on single-digit natural numbers, assumed to be the basic units of numerical cognition, asking whether there are numbers that have a (distinct) special status as the smallest and largest magnitudes. The automatic end effect (AEE), defined as an enlarged Stroop-like size congruity effect that is insensitive to intra-pair numerical distance in a physical comparison task, was used as a means to determine which numbers serve as the ends of the set. It was found that the number 9, although it is the largest number of the set, is not processed as an upper end, as indicated by the absence of the AEE (Exp. 1). Instead, it was shown that two-digit numbers, and specifically the numerical syntax of the two-digit numbers, are represented in LTM as the upper end of single-digit primitives (Exp. 2 and 3). This demonstrates that the analog representation of numbers is limited to single-digit numbers and numbers outside of that category are not represented along the same mental number line. The AEE can therefore be interpreted as reflecting order relations between different numerical categories.

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### **Conflict Resolution in Numerical Cognition: The Role of Emotional States.**

MARÍA ÁNGELES LEYVA, PEDRO MACIZO, ALBERTO ACOSTA, *University of Granada*.

We evaluated whether affective state of individuals modulated conflict resolution in numerical cognition. Participants were induced to a negative or a positive mood and, afterwards, they performed a number comparison task with two types of trials: In unit-decade compatible trials (36-47), the decades and the units of one number were larger than those of the other number; in unit-decade incompatible number pairs (37-46), the decade of one number was larger but the unit was smaller than those of the other number. The unit-decade compatibility (incompatible minus





compatible trials) was considered an index of conflict situation in numerical processing. Participants in which a negative mood was induced showed large compatibility effect relative to participants subjected to a positive mood. The way in which emotional state determines conflict resolution in numerical cognition is discussed. This is the first study demonstrating that affective states modulate conflict resolution in numerical cognition.

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### Using Numerosity Productions to Study Mathematical Development: Evidence for an Operational Momentum Effect in Preschoolers.

OLIVER LINDEMANN, *University of Potsdam*.

The operational momentum (OM) effect describes the systematic bias to overestimate the outcome of addition as compared to subtraction problems. While this bias has been found in 9-month old infants and adult subjects, the existence of a typical OM effect in preschoolers is controversial. In the present study, 6-year old children were instructed to solve non-symbolic arithmetic problems and to indicate their judgments by producing a dot cloud that matches the outcome in numerosity. In contrast to previous studies using other types of responses, the data from this numerosity production task revealed a typical OM effect in children of this age. Performances in the numerosity productions task were furthermore compared with a number-to-position task. Together, the findings provide new evidence for the validity of the method of numerosity productions to examine approximate number skills and suggest that the OM effect is not disappearing or inverting at the age of 6 and seems to be rather a stable phenomenon occurring at each stage of the mathematical development.

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### The Holistic vs. Componential Processing of Prices.

PEDRO MACIZO, PATRICIA MEGÍAS, ESTEBAN MARTÍN, *University of Granada*. There is only one study in which it is evaluated whether prices are processed holistically or in a componential manner (Cao, B., Li, F., Zhang, L., Wang, Y., & Li, H. (2012). The holistic processing of price comparison: Behavioral and electrophysiological evidences. *Biological Psychology*, 89, 63–70). Cao et al. showed distance effects when the distances were defined holistically but not when they were defined in terms of the digits. These results were interpreted as evidence for the holistic processing of prices. In the current study, we showed that the results reported by Cao et al. could be due to the compatibility between the digits and the monetary category of prices which called into question the conclusion drawn by the authors. In two experiments we obtained new evidence in favor of the holistic processing of prices after controlling for the possible compatibility effect. We conclude that, in contrast to other multi-symbolic magnitudes whose processing is componential, prices are unique representations which are processed holistically.

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### Zero is not 'Nothing'.

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The current study tested the non-symbolic representation of null numerosity (i.e., an empty set) in comparison to the symbolic representation of the number zero using the magnitude comparison task. In a series of experiments we manipulated the context by varying the type of magnitude notation or the conceptual features of the stimuli. Experiment 1 tested comparisons of the magnitudes from 0 to 9 in three different notations: symbolic, nonsymbolic and heterogeneous notations. The results revealed an attenuated distance effect for comparisons of null numerosity than for comparisons between pairs of numerosities 1-9. Experiment 2 aimed to examine whether the results of Experiment 1 marked perceiving null numerosity as zero (i.e., the smallest number in the set). This was done by contrasting comparisons to an empty set with comparisons to an abstract picture that had no numerical meaning. Experiment 3 examined whether 'zero' is perceived as 'nothing' by manipulating task instructions. The results of these experiments show that perceiving 'zero' as nothing is reliant upon the context in which it is presented. The implications of the results are discussed in light of number representation models.

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### Proactive and Reactive Control Processes in Individuals with High and Low Anxiety-Trait.

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This work focuses on exploring the effect of anxiety-trait on proactive and reactive control (Braver, 2012) on both effectiveness and efficiency while the anxiety-state level was controlled. The attentional control theory (Eysenck, Derakshan, Santos, & Calvo, 2007) proposes that the processes involved in cognitive control are modulated by anxiety. In addition, the attentional control theory assumes there is an important distinction between performance effectiveness (quality of performance) and processing efficiency (the relationship between performance effectiveness and use of processing resources). Although anxiety impairs both of them, processing efficiency would be more susceptible to anxiety levels than performance effectiveness. Forty participants (20 high anxiety-trait and 20 low anxiety-trait) performed the AX-continuous performance task (AX-CPT) which involves proactive and reactive control and provides effectiveness and efficiency indexes by registering accuracy and reaction times measures. Results showed that the two anxiety groups differ in the reaction times to the proactive and reactive control conditions, the low anxiety-trait group was faster than the high anxiety-trait group, although error rates of both groups were equal in the proactive condition and marginally significant in the reactive control condition. This pattern is consistent with the idea that efficient executive control is related to trait-anxiety levels. The results are discussed in the context of the attentional control theory proposed by Eysenck et al. (2007).

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### An Online Research Study on Motivated Forgetting of Mathematics.

IAN M. MCDONOUGH, *The University of Alabama*, JIN LING, *GERARDO RAMIREZ, University of California*.

Math anxiety—the acute fear of situations that involve math—plays a significant role in students interests, avoidance and ultimately achievement in mathematics (Hembree, 1990). Our objective in this study was to investigate whether math anxiety might relate to forgetting of math relevant content – particularly among individuals with higher math identity who are motivated to maintain their self-integrity. We used a quasi-experimental design to present an online sample of participants with a series of word blocks that contained math relevant items (i.e., calculus, matrix, fraction) which participants were instructed to commit to memory. After each word block, participants were given a cue to either remember or forget the preceding block of words and then solve a series of cognitively demanding math problems that were meant to create an aversive math learning environment. At the conclusion of the experiment, we gave all participants a surprise memory test where they were asked to recall all of the words that were previously presented (including the words that they were cued to forget). We found a three way interaction,  $F(1,61)=3.65, p=.06$ . For people with high math identity: we observed a greater forgetting rate for individuals high relative to low math anxiety. For people low in math identity: we found no difference in forgetting rate across individuals with high and low math anxiety. This work highlights the motivational (rather than passive) reasons why some students may forget important math relevant material.

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### Developmental Patterns of Processing Ordinality: Symbolic, Non-Symbolic and Visual Cues.

DANA SURY, ORLY RUBINSTEN, *University of Haifa*.

Recent research highlights the importance of the perception of ordinal relationships in numerical cognition. Here, we focus on the developmental aspect of ordinality and investigate whether young children can perceive ordinal aspect of numerical stimuli (symbolic and non-symbolic).

We report three studies that are aimed to evaluate the cognitive basis of numerical ordinal processing: (1) Hebrew speaking Israeli children (5-9 y.o.) completed an ordinal judging tasks with quantities (i.e., dot patterns) or Arabic numbers while the direction of the sequence (ascending/descending) was manipulated. However, from school age, responses to ordinal sequences were modulated by direction; in the symbolic task, ordinality effect was significant only in the 8-9years old group. (2) In Belgian children who use a left to right writing system, the effect of direction was reversed (i.e., the ordinal ascending direction was processed more accurately). (3) Children (6-11 y.o) and a group of adult completed ordinal Stroop tasks with quantities (i.e., dot patterns) as the relevant dimension. Visual properties of the stimuli were manipulated into two conditions: congruent or incongruent to the quantity presented (e.g. area of the dots increase while quantities decrease). In all three groups, results show a congruity effect; visual properties affect the ordinal judging of quantity. Hence, ordinality is inattentively processed and affects the very basic cognitive abilities such as estimations of quantities.

These findings suggest that from an early age, humans inattentively extract the ordinal features from low visual features; additionally, there might be two separate cognitive representations of ordinal and quantity information.

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### Influence of Selecting Reference Points That Suit For a Motor Intension on Motor Control during Visuomotor Tracking Task.

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Adaptive behaviour in changeable environments relies on the visuomotor ability to coordinate self-movements to moving targets. Behavioral evidences have showed that the ability to utilize visual information is associated with the ability of adaptive visuomotor control. In daily goal-directed continuous visuomotor coordinations such as vehicle tracking, drivers are required to select reference points of spatial-extended target and effector (the forward / own vehicle), then, match their movements. To clarify the influence of selecting reference points that suit for a motor intension on motor performance, this study investigated whether selecting center points from spatial-extended objects influences motor performance during visuomotor tracking. Participants ( $N = 93$ ) tracked the center of a spatial-extended target that moved sinusoidally on a horizontal direction by the center of a spatial-extended cursor manipulated by a joystick. We prepared three conditions; spatial extended target and cursor condition (Experiment1); spatial-extended target condition (Experiment2); spatial-extended cursor condition (Experiment2). We found three results; 1) the bigger object size degrades the tracking performance (Experiment1), 2) the bigger discrepancy between target and effector size produces the worse tracking performance (Experiment1), 3) selecting reference point of a target is more difficult than that of an effector (Experiment2). Therefore, we suggest that selecting of reference points influences motor performances during visuomotor control.

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### Language Processes

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### Relative Meaning Frequencies for Homonyms in Two Spanish Dialects.

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Relative meaning frequency is a critical factor to consider in studies of semantic ambiguity. In Spanish, however, relatively meaning frequency norms for homonyms are scarce and out of date. In the present study, we collected norms for 578 homonyms in two Spanish dialects—European Spanish and Rioplatense Spanish—using a computer-assisted norming approach based on dictionary definitions. The results show that the two dialects differ considerably in terms of the relative meaning frequencies of their



constituent homonyms and that the overall distributions of relative frequency vary considerably between English and Spanish, as well. In quantifying the reliability of the norms, we also established that only seven ratings are needed to converge on a highly stable set of ratings. These results provide a possible explanation for some of the discrepant effects of homonymy reported in previous studies and underscore the importance and feasibility of developing localized norms.

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### Tracking Second Thoughts: Continuous and Discrete Revision Processes During Visual Lexical Decision.

LAURA BARCA, GIOVANNI PEZZULO, *Institute of Cognitive Sciences and Technologies, ISTC-CNR, Rome.*

Visual lexical decision is a classical paradigm in Psycholinguistic and the lexicality effect (i.e. faster and more accurate processing of words than nonwords) has been assessed in numerous studies. Stimuli are categorized as either lexical or nonlexical, but the underlying decision is not necessarily a discrete process. We argue that it would be better described in terms of a dynamic competition between candidate alternatives (lexicality vs. non-lexicality of the stimulus).

To unfold visual lexical decision in time, we measured participants' hand movements toward one of two item alternatives by recording the streaming x, y coordinates of the computer mouse. Participants categorized as 'lexical' or 'nonlexical': High/Low frequency words, Pseudowords, and LetterStrings. Spatial attraction toward the opposite category was present for low frequency words and pseudowords. Increasing stimuli ambiguity lead to enhanced movements' complexity and trajectories' attraction to competitors, as no such effect was present for high frequency words and letter strings.

Kinematic profiles of the movements revealed that Pseudowords' peak velocity occurred with 100ms delay with respect to words and LetterStrings. Acceleration profile for High and Low Frequency words and LetterStrings exhibited a butterfly plot with one acceleration peak and one deceleration peak. Differently, Pseudowords' acceleration profile had double positive peaks followed by movement deceleration, in correspondence with changes in the decision from lexical to nonlexical response buttons. Results speak to different online processes during the categorization of Low Frequency words and Pseudowords, with a continuous competition process for the former and a discrete revision process for the latter.

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### Electrophysiological and Neural Correlates of Visual and Semantic Training of New Words.

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Word visual representations, essential for fluent reading, are acquired by mean of repeated visual exposition to words. In addition to visual representations, semantic features of the new words are developed during this training. The aim of this study is to determine the contribution of semantic training, as compared to simple visual

training, to the lexical acquisition, attending to changes produced in the ERP signals. For that purpose, 28 participants were repeatedly exposed to new stimuli (pseudowords) in two separately conditions during a lexical decision task. In the visual training condition, only visual information about the stimuli was provided whereas in the semantic training condition the stimuli were preceded by a picture in order to improve both their visual and semantic knowledge. Cluster-based random permutation analysis showed differences between simple visual and semantic training in two ERP components typically related to lexical and semantic processing. An increased P200 for semantically trained pseudowords showed the effort to link the picture with the visual stimulus; the improvement of this perceptive process is reflected in the activity increase in the left and right lingual gyrus. The reduction of the negativity in N400 after semantic training showed the decreasing in cognitive effort for the stimuli under this training, as is reflected in the activity reduction in the left frontal regions. In addition, semantic training showed the involvement of areas related to visual semantic association process, as fusiform gyrus and superior and middle temporal regions of the right hemisphere, which increase their activity throughout the task. Email: Beatriz Bermúdez-Margaretto, [bermudezbeatriz@uniovi.es](mailto:bermudezbeatriz@uniovi.es)

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### Effects of Massed and Spaced Repetitions on Word-Meaning Priming.

HANNAH BETTS, ZHENGUANG CAI, JENNIFER M. RODD, *University College London*. Listeners use sentence context to understand words with multiple possible interpretations (e.g. 'bark' – dog/tree). However, recent experience is important in determining how these words are disambiguated: comprehenders are more likely to disambiguate a word towards the meaning they have recently encountered just once (Rodd, Lopez Cutrin, Kirsch, Millar & Davis, 2013). Such word-meaning priming occurs presumably because a previous encounter strengthens the particular word-meaning linking, making the primed meaning more accessible for subsequent retrieval. The present study investigates how *multiple* word-meaning encounters influence the subsequent interpretation of word meanings. In two experiments, participants heard words in the context of their subordinate meanings. These words were repeated either once or three times within paragraphs (massed; Experiment 1), or once or three times across different experimental blocks (spaced; Experiment 2). After a filler task (ensuring a 30-minute prime-test delay), participants provided associates to ambiguous words presented in isolation (e.g. 'tree' as a response to 'bark') - a task that enabled us to assess how they interpreted the ambiguous words. Both experiments demonstrated significant word-meaning priming following one repetition of the meaning. Whilst three massed repetitions provided no *additional* boost in priming (Experiment 1), three spaced repetitions significantly boosted priming to a level that surpassed that of one repetition (Experiment 2). These results suggest that multiple encounters with a word-meaning must be spaced for them to act as separate instances in terms of further strengthening the form-to-meaning mapping of a word. Email: Hannah Betts, [hannah.betts.10@ucl.ac.uk](mailto:hannah.betts.10@ucl.ac.uk)



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### Repairing Degraded Speech With and Without the Lexicon: The Role of Phonotactics and Perceptual Repair.

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To comprehend natural speech, listeners must frequently overcome distortion of word forms due to phonetic reduction, mispronunciations, noise, and other factors. Lexical information can be used to repair degraded speech (cf. Ganong and phoneme restoration effects), but sometimes repair is also possible without the lexicon, via knowledge of language-specific constraints on sound sequences (i.e. phonotactics). For instance, Spanish prohibits word-initial /s/-consonant clusters, repairing them via prothetic /e/ where necessary (e.g. English *snob* was adopted as Spanish *esnob*). As a result, Spanish speakers tend to perceive an illusory /e/ before /s/-consonant sequences (Cuetos, et al., 2011; cf. Dupoux, et al., 1999a, 1999b). This study explored how native Spanish speakers interactively rely on their phonotactic and lexical knowledge to restore degraded speech in auditory lexical decision. The critical stimuli were vowel-/s/-consonant-initial words such as *espalda* 'back', where the initial vowel matches the perceptual illusion, and *aspecto* 'aspect', where it does not. These words were presented intact, with the initial vowel removed, or with their initial vowels switched. Intact words were recognized quickly and accurately (93%). Crucially, removing an initial /e/ (e.g. *espalda* > *spalda*) had no effect on recognition accuracy (94%) or RT, but removing a different vowel (*specto*) led to slower and less accurate (57%) recognition. When the vowels were switched, recognition fell to 25%. These results suggest that perceptual illusions based on phonotactic knowledge lead to fast, accurate repair of degraded speech, but where such repairs are misleading, a second repair path, via lexical information, is available, albeit less reliable.

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### Does Language Prime Faces?

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When you learn to associate a person with the language they speak, seeing that person can prime the associated language and thereby support language processing (Molnar, Ibáñez-Molina, & Carreiras, 2015; Woumans et al., 2015). Our study explored whether this association also works the other way around: Does activation of a particular language guide visual attention to faces of speakers of that language? Dutch-English bilinguals were first familiarised with male interlocutors speaking either English or Dutch. Then, listeners' eye-movements were measured while they listened to English or Dutch sentences produced by a female speaker and looked at four pictures of interlocutors on the screen. If the association also exists in the opposite direction, participants are expected to fixate on speakers of English more often than on speakers of Dutch while listening to English sentences and vice versa.

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### Bilinguals' Reaction To Cultural Statements Differs Between Languages.

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Recent studies have revealed remarkable interactions between language and emotion. Here, we show how such interactions affect the processing of information concerning one's native culture. Balanced Welsh-English bilinguals (n=20) were asked to make a truth-judgment on statements that present Welsh culture in either a positive or a negative light. Statements were fully rotated and counterbalanced between participants to ensure that each experimental statement was not repeated, not even by way of a translation equivalent. Our results show a striking interaction between emotional valence and language of presentation on the accuracy of truth-judgments. Whilst participants categorized positive statements as true when they were true, they were biased towards categorizing them as true *also* when they were false. This was the case whether statements were read in English or Welsh. Participants were also biased to categorize negative statements as false when they were true. Surprisingly however, this bias was significantly more pronounced in their second language, English, than in their native language, Welsh. Furthermore, when the negative statements were false, and presented in English, participants were better able to denounce their falsehood. These findings demonstrate a global cognitive bias for positive information, which contrasts with the dissociation for negative information; where the second language appears to act as a shield from detrimental information regarding one's culture. We conclude that these data show that languages, even within the same individual, play a fundamental role in shaping the relationship between emotions and cultural identity.

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### Reader's Geographical Perspective in the Comprehension of Deictic Narrative Mediated By the Verbs 'To Be' and 'To Come'.

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In face-to-face communication we usually take our own current here-and-now as reference point. However, to properly understand a narrative, readers must be able to take the protagonist's spatial perspective in their fictitious environment rather than using their own. In a previous study we found that the place in which a reader is geographically situated affects the processing of narratives that describe geographical displacements (de Vega, 2015). We explore whether readers of narratives rely by default in their own deictic center during narrative comprehension. For that purpose, we gave participants the description a character (e.g. Montse), living in a city (e.g. Barcelona). Our main prediction was that readers would interpret narratives mediated by verbs on the basis of what is close (e.g. Barcelona) and distant for the protagonist (e.g. Sevilla), moreover we predicted that the own location (e.g. Tenerife) will obtain a gain in this judgement. Results showed that in the context of the motion verb, coherence ratings were higher for close- places than for distant places. We also found differences between the places where the experiment take part and the distant place. For the stative verb there were no differences. Those findings provide information





about readers' perspective taking, guided by the deictic verbs of motion, during the comprehension of narratives. New experiments with ERP are being carried on to explore the brain response.

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### **Affective Norms of 2266 Spanish Words for Five Discrete Emotional Categories.**

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Many studies investigating emotional word processing have relied on the two-dimensional model which focuses on the dimensions of valence and arousal. An alternative account, the so-called discrete emotion theories, assumes that all emotions can be derived from a limited number of universal affective states such as fear, anger, disgust, sadness, and happiness. To contrast these two models it is necessary to conduct experiments with words characterized in valence and arousal as well as in discrete emotion categories. However, most of the published affective norms have been elaborated from the two-dimensional model. We present a normative database for 2266 Spanish words rated by 1380 participants in five discrete emotional categories, including happiness, anger, fear, disgust and sadness. We investigated the relationship among the five emotional categories with a multiple correspondence analysis. Furthermore, we explored the pattern of correlations between the emotional categories and the valence and arousal ratings for these words reported in other affective databases (Ferré et al., 2012; Guasch et al., in press; Redondo et al., 2007). We also studied the correlations with other semantic variables, such as concreteness. Finally, as all the words of the Spanish ANEW database were included in this study, and ratings for discrete categories are available for the English ANEW database we examined the correspondence of these ratings across languages. Overall, the results indicate that this new corpus is a suitable tool for conducting experiments to examine effects of the affective category on word processing.

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### **A Database of Normative Ratings for 530 Ambiguous and Unambiguous Spanish Words.**

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This study presents normative data for 386 ambiguous and 144 unambiguous Spanish words. Two subjective measures of semantic ambiguity and two subjective measures of relatedness of ambiguous words' meanings (ROM) were collected. Furthermore, subjective ratings were obtained for some relevant lexico-semantic variables, such as concreteness, familiarity, emotional valence, arousal and age-of-acquisition. The present database overcomes some of the limitations of the published databases of Spanish ambiguous words; namely, the scarcity of measures of ambiguity, the lack of subjective ROM measures, the lack of values concerning relevant variables

that are known to affect word processing, and the absence of a set of unambiguous words. In addition, we conducted several analyses to assess the validity of our ambiguity and ROM measures. Regression analyses on lexical decision times showed the predictive power of these measures, supporting their psychological validity. Moreover, correlational analyses revealed significant correlations between them and objective measures of ambiguity (i.e., dictionary entries and dictionary senses). In sum, the database will be very helpful for researchers interested in lexical ambiguity research, specially, to assist them in categorizing ambiguous and unambiguous words, in categorizing ambiguous words that differ in the relatedness of their meanings, and in preventing any experimental confound due to uncontrolled variables.

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### **Effect of the Semantic Context Items Learned as Sequence.**

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When individuals have to name Arabic digits in a context where all the items to be named are exemplars from the same semantic category (i.e., Arabic digits), the responses are faster than in a context where the items are from different semantic categories. This facilitation effect produced by the blocked semantic context relative to the mixed context differs from the interference effect that is usually observed when items to be named are pictures. This semantic facilitation has been also observed when numbers are presented as number words. The absence of interference, as is usually interpreted, seems to indicate that naming numbers, for both Arabic digit and number words, may proceed without semantic access. However, it is unclear the origin of the facilitative effect. The present work evaluated whether this effect could be common to other stimuli that, as numbers, are learned as sequences. In Experiment 1, participants were asked to read words from four categories. Two categories were sequences (i.e., number words and days of week) and two categories were not sequences (i.e., animals and furniture). In Experiment 2, participants have to name graphic symbols, Arabic digits, letters and animals. The results of both experiments showed a facilitation effect of the blocked context relative to the mixed context when the items pertained to a sequence. The results are discussed in terms of associative links and models that defend the existence of connections between lexical representations that have developed on the basis of frequently co-occurrence.

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(53)

### **Automation in Writing Acquisition: The Impact of Letter Complexity on Grapho-Motor Development.**

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To learn how to write children must render graphomotor gestures automatic. Automation leads to smooth and continuous movements, that allow the child to use cognitive resources for processing other aspects of writing (e.g., spelling). At the beginning of writing acquisition, complex letters with many strokes constitute strong cognitive loads. The children write stroke by stroke. With practice, they "put the strokes together" and writing becomes smoother. In adult-like writing, each letter is represented as one motor program

irrespective of its complexity. Although this evolution is a common observation, there is scarce empirical data documenting it. The goal of the present study is to shed some light on how children evolve from stroke to whole letter programming. Our research examined how French 6 to 9 year old children “build up” motor programs for cursive letters of varying complexity: l = 2 strokes, j = 3 strokes, h = 4 strokes, z = 5 strokes. They wrote the letters on a digitizer. We observed that movement duration and dysfluency decreased from ages 6 to 8, and remained stable from ages 8 to 9. This suggests that automation in writing begins at age 8 and confirms the findings of previous studies. The results also indicated that at ages 6 and 7 movement time and dysfluency increased with letter complexity (i.e. stroke number). For the 8 and 9 year olds, letter complexity did not seem to affect movement kinematics significantly. Automation therefore results from stroke chunks to letter-sized motor programs. Email: Laurence Séraphin-Thibon, [Laurence.thibon@gipsa-lab.grenoble-inp.fr](mailto:Laurence.thibon@gipsa-lab.grenoble-inp.fr)

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### What Mechanisms Underpin Priming of Lexical Access in Spoken Word Retrieval?

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In the literature, the representation of the meaning of a word (semantics) has been modeled either as a network of holistic (nondecomposed) nodes or as a decomposed set of features. Despite experimental studies showing that semantic relatedness and association have different effects on word retrieval, these models primarily focus on semantic coordination, and neither model clearly implements a wider range of semantic and associative relationships. The current study aimed to contribute to this discussion by examining the role of semantic coordination with and without association (e.g., associated ‘car’ – ‘bus’ and not associated ‘ferry’ – ‘bus’), association without coordination (e.g., ‘conductor’ – ‘bus’), and part-whole relations (e.g., ‘tyre’ is a part of ‘bus’) in lexical access in spoken word retrieval using long-lag priming of picture naming by reading the word form.

Experiment 1 found an inhibitory effect of associate-coordinates and associate-not-coordinates driven by the association from the target to the prime. Experiment 2 replicated the inhibitory effect of associate-coordinates and showed no significant priming from parts on word retrieval.

We suggest that associative relatedness can produce inhibitory effects when there is associative link from the target to the prime and if there is sufficient overlap of semantic features.

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### Parafoveal-on-Foveal and Preview Effects: Evidence from Fixation Related Potentials.

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During reading, parafoveal information could affect the processing of the word currently fixated (i.e. parafoveal-on-foveal effect). Furthermore, words perceived parafoveally can facilitate their subsequent processing when they are fixated on (i.e. preview effect).

Whereas data obtained by the eye-tracking technique supporting parafoveal semantic processing or parafoveal-on-foveal effects are scarce and controversial. Recent electrophysiological research suggest that, under some circumstances, parafoveal information can be fully processed and quickly integrated in the ongoing context. In this experiment we investigated electrophysiological correlates of parafoveal processing during word pair reading. We simultaneously recorded eye movements and EEG measures to analyze if a word perceived in the parafovea modulates the level of foveal processing (parafoveal-on-foveal effect), and the impact of this information after a saccade, during processing of the next word (parafoveal preview effect). To this aim we combined the Fixation Related Potentials (FRPs) technique with the invisible boundary paradigm. ERPs time locked to the word pair presentation showed a *parafoveal-on-foveal effect* on the N400 component associated to the processing of the first word. The FRPs time locked to the saccade offset show a semantic relatedness effect in P2 and N400 component. These findings indicate that under some circumstances, semantic relatedness information can be detected during parafoveal perception.

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### Training Non-native Contrast Discrimination Using Dialectal Variants.

ANNIE J. OLMSTEAD, *University of Kansas*, NAVIN VISWANATHAN, *University of Kansas & Haskins Laboratories*. Native American-English (AE) speakers have difficulty distinguishing between dental and retroflex stop consonants. This difficulty is predictable because these phones are not phonemically distinct in AE. When asked to classify voiceless retroflex and dental stops, AE listeners typically label both items /t/. While this distinction does not exist in AE, it does exist in the phonemic inventory of Indian English (IE) a dialect of English spoken on the Indian subcontinent. Specifically, these phones are used to instantiate the /t/-/ḍ/ distinction in AE such that the dental /t/ is used in instances where /ḍ/ would be used in AE while the retroflex /ɭ/ is used in place of /t/. This situation provides us with opportunity to present information about the dental-retroflex difference in naturally produced tokens of English. In a previous study, we showed that AE listener’s discrimination of the dental and retroflex improved after they performed a lexical decision task (LDT) in which they judged words produced by an IE native speaker. In the current study, we investigate how feedback in the LDT may affect participant’s improvement in the discrimination task. Participants performed a pretest diphone discrimination task followed by an LDT in which they were presented with words spoken by an IE native speaker. We compared three feedback types, correct consistent, incorrect consistent, and random and found that feedback in the LDT does not improve phonetic discrimination in a post-test. Interestingly, there was marked individual variability in discrimination. Implications of these finding will be discussed.

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### Frequency Effects in First and Second Language: An Individual Differences Approach.

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Research examining frequency effects in bilinguals to date has mostly compared first and second language speakers of the same language (e.g. Gollan et al., 2011), or has investigated bilinguals whose languages share the same orthography (namely, the Roman alphabet, e.g., Whitford & Titone, 2012). Results have demonstrated that the magnitude of frequency effects depends on the level of language exposure, that is, frequency effects tend to be larger in speakers with lower language proficiency, supporting the frequency lag hypothesis (Gollan et al, 2011). However, it is as yet unknown whether frequency effects in L1 and L2 tend to be correlated in bilingual speakers, supporting general properties of lexical organization, or whether they are language-specific, thus more strongly script-dependent and determined by exposure to each language. In the current study, we probe this issue in Hebrew-English bilinguals, languages that use different orthographies, in order to limit cross-language interactions. Further, Hebrew and English differ in their orthographic depth, which can modulate the effect of word frequency (Frost, Katz & Bentin, 1987). Young adults participants performed two lexical decision tasks, one in their L1 (Hebrew) and one in their L2 (English), and lexical frequency was manipulated. We further assessed individual differences in proficiency and exposure to the two languages, as well as cognitive control. Results are discussed in the context of theories of lexical representation in first and second language, and cross-script differences in the impact of word frequency on reading.

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### Domain-General Serial Order Mechanism May Be Involved in Word-Learning.

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Research indicates functional similarities between verbal and visuospatial domains of short-term memory (STM) with respect to serial order processing, highlighting the possibility of a domain-general ordering mechanism. Moreover, a growing body of work has elucidated strong relations between serial order STM capacity and word-learning ability, suggesting that a similar domain-general ordering mechanism may be at play within the language acquisition system. Two experiments addressed a) whether serial order processing is domain-general and b) whether serial order STM underlies vocabulary learning. Experiment 1 directly investigated whether verbal and visuospatial STM rely on common ordering mechanisms using a delayed recall dual-task design that contrasted two types of visuospatial interference tasks during a concurrent verbal serial order memory task (digit sequence memory). The visuospatial tasks probed either serial order STM or non-serial order (item) STM. Serial-order-specific interference effects with the concurrent digit sequence STM task were found. Experiment 2 found similar serial-order interference as Experiment 1 but now with an English-Tamil word-learning paradigm as a concurrent task in place of the verbal serial order STM task. Again, reliable interference by a visuospatial STM task was found only when it required memory for serial order. The findings suggest that verbal and visuospatial STM domains rely on common mechanisms for

serial order processing and that such domain-general serial ordering mechanisms are also involved in novel word-learning.

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### Investigating Spatial Integration of Information beyond the Sub-Lexical Level in Reading.

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A longstanding question in reading research has been whether we process multiple words in parallel. Several recent studies have shown that fixation durations on a target word decrease when that target is repeated as the post-target word. When isolated targets are flanked by their constituent bigrams (e.g. *ro rock ck*), word processing is facilitated in a similar way. We have recently proposed a model of reading that accounts for these findings, by assuming that orthographic information from multiple words is integrated on the sub-lexical level. Additionally, the model assumes that multiple words may be activated by a given pool of orthographic information, leading to competition for recognition on the level of whole-word representations. In the current study we aimed to validate this assumption, by testing whether foveal targets may be *inhibited* by parafoveal orthographic neighbors, signaling lexical competition. We employed the gaze-contingent boundary paradigm to manipulate parafoveal information in sentence reading, as well as the *Flanking Letters lexical Decision* paradigm to investigate parafoveal influences in single-word reading. We found that parafoveal neighbors *facilitated* rather than inhibited target processing, reaffirming the conception that information is integrated on the sub-lexical level; but not to induce competition between multiple lexical representations.

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### Between-Language Repetition Priming in Antonym Generation.

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Previous literature has demonstrated conceptual repetition priming across languages in bilinguals. This between-language priming effect is taken as evidence that translation equivalents have shared conceptual representations across languages. However, the vast majority of this research has been conducted using only concrete nouns as stimuli. The present experiment examined conceptual repetition priming within and between languages in adjectives, a part of speech not previously investigated in studies of bilingual conceptual representation. The participants were 100 English-Spanish bilinguals who had regular exposure to both languages. At encoding, participants performed a shallow processing task and a deep processing task on English and Spanish adjectives. At test, they performed an antonym generation task, in which the target responses were either adjectives presented at encoding or control adjectives not previously presented. The measure of priming was the response time advantage for producing repeated adjectives relative to control adjectives. Significant repetition priming was observed both within and between languages under deep, but not shallow, encoding. The results indicate that the conceptual representations of adjective translation equivalents are shared across languages.

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### Low-Level Visual Effect in Word Recognition: Priming by Word Length in a Lexical Decision Task.

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This study investigates interaction between low-level visual effect and word processing, focusing on the word length characteristic, presumably conveyed by the magnocellular visual system. Experiment 1 evaluated priming by word length in a masked priming paradigm using meaningless strings of characters as prime that were the same length (SL), shorter or longer than 5 or 9 letter targets. Results showed 1/ a main effect of prime on error rate (%E) with less error for a SL prime, relative to shorter or longer primes, 2/ an interaction between prime and target length, as %E was lower for SL prime than for short prime and even higher for long prime for 5 letter target whereas %E was lower for SL prime than for both long or short primes for 9 letter target, and 3/ an interaction between prime and participant reading level, as length priming was found for less-good readers only. Experiment 2 focused on the dissociation between magnocellular (M) and parvocellular (P) visual systems using P biased (red stimuli on an isoluminant green background) or M biased (grey stimuli on a lighter grey background) stimuli. Results demonstrated a modulation of length priming effect according to visual manipulation, with higher priming for long prime when M system was isolated and for SL prime when P system was isolated, suggesting that both systems play a role in length coding. Taken together, these results demonstrate that word length is a relevant characteristic for word processing, and should be conveyed by P and M systems.

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### Neural Overlap of L1 & L2 Semantic Representations in Bilinguals: An MVPA Approach.

EOWYN VAN DE PUTTE, WOUTER DE BAENE, WOUTER DUYCK, *Ghent University*.

Studies have shown very divergent findings as a consequence of methodological heterogeneity and the lack of distinction between language modalities (comprehension vs. production). The classical fMRI approach can't distinguish neural overlap as a result of different neural populations representing the different languages within the same brain area or the same neural population within the same brain area representing both languages. That's why an important goal of this study was to make a shift towards multi-voxel pattern analysis (MVPA) to get a better idea about how specific the neural overlap is between L1 & L2 by looking at prediction accuracies instead of looking at the amount of activation.

More specific, a pattern classifier was trained on the activation pattern associated with the naming, reading or listening to each of the 10 concepts in one language for 5 of the 6 blocks (training data). Subsequently, this pattern classifier was used to classify the activation pattern associated with the naming, reading or listening of the 10 concepts in the corresponding sixth block of the other language (test data). The results showed that the classifier was able to accurately predict which concept was named in the different language modalities (production, auditory comprehension and visual comprehension). Although the brain regions in which significant decoding accuracies were observed did show overlap across the different modalities, we also found brain regions which

were specific for the different language modalities.

Overall these results provide evidence for at least partly overlapping conceptual representations across languages.

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### Encoding and Retention of the Bilingual Memory.

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How information is encoded affects its memory representation. Despite a body of literature showing L2 disadvantages, previous research has provided little evidence for disadvantages in L2 word list recall. In addition, word list recall can be modulated by semantic organization of word lists during encoding. In this experiment we examined the effects of encoding language and the semantic organization of word lists on free recall performance with multiple encoding-recall intervals. 120 native speakers of Dutch in Belgium were equally and randomly distributed according to three between-subject factors: language (L1 vs. L2), semantic organization (blocked, implicit, explicit and control), and interval (day, week, and month). Mixed-effects logistic regression analyses show no evidence for L2 disadvantages in immediate and delayed recall. Although we observed the smaller memory decay in L2 than in L1, it was only marginally significant. This can be at least partly explained by encoding time per item. Encoding time is longer in L2 than in L1 and significantly explains the memory success in both immediate and delayed recall. Availability of semantic organization in the lists had beneficial effects on immediate recall but less clearly on delayed recall. In sum these results suggest that there is no L2 disadvantage in word list recall but the bilingual memory can be established more effectively with longer encoding time and the access to the semantic organization.

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### Eye-Tracking the Time Course of Novel Word Learning and Lexical Competition in Adults and Children. Is There Evidence For Sleep-Associated Memory Change?

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Lexical competition is a hallmark of proficient and automatic word recognition. Previous research with children and adults suggests that there is a delay before a new word begins to compete for recognition, with sleep playing an important role. In contrast, recent data from the visual world paradigm suggest that adults show interference from a novel competitor when asked to respond to an existing referent *immediately* after learning. The present study trained 42 adults and 40 children (aged 7-8) on novel word-object pairings, employing the visual world paradigm to measure the time course of lexical competition. Fixations to novel objects (e.g., looks to the novel object *biscal* upon hearing "click on the *biscuit*") were compared to fixations on untrained objects. Novel word-object pairings learned immediately learned the previous day before testing exhibited significant competition effects in children and adults, but stronger competition for the previous day pairings in children. Crucially, this effect was significantly smaller for novel competitors than for existing competitors suggesting that novel





items may not compete for recognition as fully-fledged lexical items, even after a night of sleep. Explicit memory (cued recall) was superior for words learned the day before testing; this effect correlated with sleep spindle density. These results suggest different aspects of word learning follow different time courses: competition effects emerge swiftly, but are qualitatively different those observed with known words. The findings are consistent with the view that word learning in development is boosted by sleep to a greater degree than in adulthood.

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### **Categorization of Everyday Objects: A Cross-Linguistic IRT-Study.**

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Cross-linguistic research has shown that boundaries for lexical categories differ from language to language. Further exploring these language specific differences by means of an IRT-approach (Item Response Theory) enables us to take into account within group differences as well as between group differences. A category judgment task for four roughly equivalent categories with 40 items per category was performed by monolingual Dutch- (N=400) and French-speaking (N=300) Belgian adults (age 17 to 75). The stimulus sets consisted of pictures of storage containers. Each stimulus set included good, borderline, and bad examples of the target lexical categories. Large differences in the internal category structure of roughly equivalent categories in the two languages were demonstrated by Differential Item Functioning Analysis. In spite of these large structural differences between the two language groups, a Latent Class Analysis did not succeed in identifying the two language groups based on the categorization patterns. Per category, two to five latent groups of categorizers were identified that only partially corresponded with the two language groups. A multinomial logistic regression analysis showed that apart from language, age played a significant role in the prediction of lexical category for a particular group of categorizers. Complex patterns of lexical variation thus exist, even for categories of everyday objects: They are not only shaped by language, but also by age.

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### **Modulation of Associative and Categorical False Memory By tDCS.**

M. ÁNGELES ALONSO, *Universidad de La Laguna*, ANTONIO M. DíEZ, *Universidad de Salamanca*, IDAIRA FERNÁNDEZ, *Universidad de La Laguna*, EMILIANO DíEZ, *INICO, Universidad de Salamanca*, CARLOS J. GÓMEZ-ARIZA, *Universidad de Jaén*, ANGEL FERNANDEZ, *INICO, Universidad de Salamanca*. The results of previous studies indicate that tDCS of the temporal lobe (TL) while participants study lists of related words has effects on the false recognition of unrepresented words. With the aim of further examining the memory-distortion processes being affected by the stimulation, we conducted a DRM experiment in which tDCS (anode/cathode/sham) was applied over the participants' left posterior temporal lobe (PTL) during the study of word lists that were either associatively or categorically related to their non-presented critical words. In a subsequent yes/no recognition test the participants showed a reliable false recognition effect under all

conditions. More interestingly, while stimulation in the left PTL did not affected associatively-induced false recognition, it led to elevated levels of false recognition for categorically related critical words. The results are discussed in relation to the nature of the associative and semantic processes involved in false memory for verbal material, and placed in the context of recent findings pointing at the differential effects of stimulation in specific locations of the TL.

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### **Resetting of Visual Working Memory Following Demanding Changes.**

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Our world is highly dynamic: items constantly move, change, and interact. The ability to interpret the environment therefore relies on tracking these changes and updating our mental representations accordingly, a process relying on visual working memory (VWM). We investigated situations in which online changes cannot be incorporated into existing VWM-representations, triggering instead a resetting of VWM contents. As an example of challenging changes, we used shapes that moved and then broke into parts. We monitored an ERP component whose amplitude rises as more information is maintained in VWM (the contralateral delay activity; CDA). Following the shapes' separation, we found a sharp *drop* in CDA amplitude, indicating that VWM temporarily lost its contents, and only then recovered to encode the new information. When the online changes were less demanding, they could be updated within existing representations, as indicated by a steady rise in CDA amplitude, without a drop. Behaviorally, during the resetting process, participants failed to identify large changes in the represented items. We next distinguished between two possible sources for the resetting: first, the cognitively-challenging individuation, and second, the perceptually-demanding visual separation of the items. When we used identical stimuli and manipulated the parts' history, highlighting their independence, the drop disappeared. We also tested whether identical stimuli would lead to either updating or resetting, depending on the task performed. Finally, we examined whether situations which require a resetting without a separation produce the same drop. Our results support the interpretation of the drop as a novel marker of VWM resetting.

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### **False Recognition and Correct Rejection of Critical Words: An ERP Study.**

SARA CADAVID, *University of Minho*, MARIA SOLEDAD BEATO, *University of Salamanca*.

Event-related potentials (ERP) were used to explore neural signatures of true and false memories in the Deese/Roediger-McDermott (DRM) paradigm. Specifically, our lists included words simultaneously associated with three nonpresented critical words. These lists significantly improve the signal-to-noise ratio in ERP studies. Since previous research has shown that Backward Associative Strength (BAS) is related to false memories production, lists were built using a wide range of BAS values. In this research, we examined the neural correlates of true recognition (TR), false recognition (FR), and correct rejection of distractors (CRD). Besides, we explored correct rejection of critical words (CRCW)

signature, usually put aside. Behavioral results indicated the existence of false recognition (false alarms to critical words higher than false alarms to distractors). Regarding ERP old/new effects, analysis showed: (1) an early frontal old/new effect (300-500 ms), where TR, FR and CRCW activities were indistinguishable between them, as well as more positive-going than CRD; (2) a left parietal old/new effect (500-800 ms) characterized by TR and FR signatures with more positiveness than CRD, and a more negative-going CRCW waveform than TR; and (3) a late right frontal old/new effect (1000-1500 ms), where TR and FR signals were similar and more positive-going than CRD and CRCW. Thus, firstly, TR, FR and CRCW seem to share common early (familiarity-based) underlying processes. Secondly, later in the test, CRCW starts to differentiate from TR (recollection processes). Finally, during monitoring processes, FR and CRCW are clearly distinguished. Results were interpreted according to the main theories in the field. Email: Sara Cadavid, [s.cadavid@psi.uminho.pt](mailto:s.cadavid@psi.uminho.pt)

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### Focal and Nonfocal Prospective Memory Tasks in 6-Year-Old Children.

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Prospective memory (PM) is an essential function of memory in everyday life since it is involved in carrying out planned activities in the future (Einstein & McDaniel, 1990). Age differences in PM have been shown to depend on whether the PM task involves focal or non-focal target events. Focal PM tasks are those in which the cue to perform the PM task can be processed as part of the ongoing task while non-focal PM tasks require active monitoring processes where the cue is not processed as part of the ongoing task (Einstein & McDaniel, 2005). The aim of the current study was to assess the effect of cue centrality in preschoolers' prospective memory. Thirty-four children aged 6-7 participated in two PM tasks (focal and non focal). The ongoing task for both PM conditions consisted of categorizing pictures according to their content ("animal" versus "non-animal"). In the focal prospective condition children were asked to press a different target key whenever the target picture appeared, while in the non-focal task, children were asked to change their response whenever the picture frame had a particular color. Results showed that PM performance was lower in the non-focal than in the focal condition. We also found a greater cost in terms of increased reaction times in the non-focal relative to the focal ongoing task. This pattern of results suggests that PM differences in 6-year-old children seem to depend on children's ability to maintain their intentions.

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### Is It Contagious? An Eye-Movement and Emg Study of Smile Authenticity Judgment.

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A smile is commonly used to mask negative emotions, yet those emotions are often leaked through microexpressions. These microexpressions act as brief displays of the individual's true emotion. Studies have indicated that participants often have

difficulty judging the emotional expressions as truly happy or not truly happy, even when the leaked emotion is displayed for extended periods of time. The current study used a smile authenticity judgment task and sought to understand why individuals have difficulty with these non-authentic smiles (masking smiles: angry brow, angry mouth, disgust, fear, sad brow, and sad mouth). Various judgment strategies were evaluated, such as explicit knowledge, attentional limitations (eye-movement measures), emotional contagion (scale; ECS), and facial mimicry (electromyography; EMG). Accuracy results were observed to be as a function of emotion, where participants are more accurate with masking smiles containing fear and less accurate with masking smiles containing anger in the brows. In addition, judgment strategies appear to be a function of emotion. For instance, emotional contagion and facial mimicry were respectively significant predictors of fear and angry mouth masking smile judgment accuracy. Alternatively, attentional limitations were a significant predictor of angry brow masking smile judgment accuracy. In sum, smile authenticity judgment of masking smiles and their respective strategies appears to be as a function emotion.

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### The Effect of Watching a Hand Draw Images on Learning from a Multimedia Lesson.

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A whiteboard video is a form of visual presentation in which pictures and text are drawn during the movie. Whiteboard videos are often used in commercials, to convey messages, but also in education (e.g. the movies at Khan Academy). Investigating this type of presentation can yield interesting results in terms of the cognitive processes that occur during multimedia learning. The current study compared these videos to presentation of a series of pictures. We let undergraduate students watch a video lesson about early embryonic development. In the video lesson either a series of pictures was presented or the same pictures were drawn during the lesson. Both lessons contained the same vocal explanation. We recorded eye movements, measured retention of the presented information and collected interest ratings. The results are discussed in light of Mayers' multimedia principles.

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### Inductive Category Effects for Emotional Facial Expressions.

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A common finding is that objects are remembered as being more typical of the category to which they belong than they actually were. The Category Adjustment Model (Huttenlocher, Hedges & Vevea, 2000) interprets this bias as resulting from a Bayesian combination of inexact information about the particular stimulus with prior information about the set to which it belongs, i.e., its category. Whereas prior work focused on simple stimuli such as lines of varying length or shapes of varying shade, the current study examined memory for faces that vary in emotional expression. Expressions from the NimStim Face Stimulus Set were morphed to



create a continuum from neutral to happy. Thirty-seven participants viewed individual images from this continuum and after a brief delay (500 or 4000 ms), adjusted a response face to make it match the face they had just seen. As in earlier work, estimates were biased toward the middle of the presented distribution and this tendency was more pronounced at longer delays. This category bias was larger for later blocks of trials, regardless of delay. The results suggest that participants use their experience with a set of emotional expressions to adjust in-face memories of particular faces, giving more weight to category information when particular-level memory is more inexact (i.e., after longer delays.) This study extends the predictions of the Category Adjustment Model to stimuli that are socially relevant, emotionally valenced, and visually complex.

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### **PowerPointLESS: Implementing Frameworks to Improve Note Taking in Lectures.**

KATIE ALICE CORIA, PHILIP A HIGHAM, *University of Southampton*.

Modern technology has meant that most university students have access to printed slide handouts (PSH) to annotate during lectures. Indeed, slide annotation has largely replaced the once prevalent practice of longhand note taking. What impact has this change had on student learning? Is there a better practice that can be encouraged to improve recall based entirely on encoding? In this study, all students watched the same 30-minute lecture but were split into five different encoding conditions; controls (who observed the lecture without note taking), annotators (who were given a PSH), longhand note takers (who were given blank paper), condensed note takers (who were only allowed to summarise the key points after each concept) and condensed note takers with feedback (as above but also provided with suggested key points after they had written their own). All participants were tested for recall both immediately and after a week-long delay, as well as providing information on their opinions on the encoding method and data about how much they felt their mind was wandering. As this experiment is currently running, the data has not been analysed but based on theories such as the testing effect, hypercorrection and my previous results demonstrating that the increased cognitive effort involved in longhand note taking leads to improved recall, it is predicted that the condensed note takers (particularly with feedback) should outperform the other groups and in turn longhand note takers should outperform annotators and controls.

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### **The Effects of Perceptual Information on JOLs and Memory Performance.**

MARIANA VEIGA CHETTO COUTINHO, *Zayed University*, BARBARA CHURCH, J. DAVID SMITH, *University at Buffalo, SUNY*.

Prior studies have reported that relying on perceptual cues (e.g., similarity, size, and loudness) when making judgments of learning (JOLs) leads to illusions of knowing (e.g., Castel, McCabe, Roediger, 2007; Mueller, Dunlosky, Tauber, & Rhodes, 2014; Rhodes & Castel, 2008; 2009). That is, people believe they have mastered a concept when in fact they have not. However, all the studies showing such results used verbal-semantic items as testing

stimuli. In the present study, we challenged the idea that perceptual variables cause illusions of knowing by evaluating the validity of these variables in predicting memory performance when the material to be remembered was visual-nonsemantic. We hypothesized that perceptual cues are accurate predictors of memory performance when the information to be remembered is also perceptual. Participants were presented with a set of abstract shapes that varied either in similarity (Experiment 1) or size (Experiment 2) and were asked to rate the likelihood of remembering these items, and subsequently performed a recognition test. The results supported the proposed hypothesis. They revealed that perceptual similarity and size influenced JOLs and memory performance. These findings suggest that illusions of knowing may be caused by the mismatch between the type of information to be remembered and the type of information used to make JOLs, and not perceptual variables per se.

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### **The Influence of Curiosity and Interest on Memory: Large Sample Study to Establish a Trivia Question Database and a Mediation Model.**

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Curiosity involves the desire to learn what is unknown. There has been increased attention to how curiosity (or interest) influences memory performance. One common way to induce curiosity in experiments is to use trivia questions. Previous studies, however, used only a limited number of trivia questions that differ substantially across studies, making it difficult for comparability and generalizability of the findings. These studies also did not differentiate between the curiosity about the question and interest in the answer. To address these issues, the current study established a normative database for 303 trivia questions with a large sample ( $N = 1897$ ). Participants were presented with trivia questions, asked to provide their best guess for the answer, rated their confidence in the guess and indicated their curiosity to learn the answer. Following the presentation of the answer, participants indicated their post-answer interest. One week later, participants were given a memory test on the questions. Our analysis showed that these epistemic states are positively (albeit not so strongly) related to memory performance. A multilevel structural equation model revealed that curiosity's relationship to memory was fully mediated by the interest in the questions' answer. Confidence had both direct and mediated effects (over interest) on memory.

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### **Verbal and Spatial Encoding Show Different Eye Movement Strategies in a Working Memory Task.**

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Saccades are being generated to focus gaze and attention on visual stimuli, therefore enhancing perception and further processing. Eye movements' beneficial role in encoding visual stimuli into memory seems to only hold true for verbal encoding, since findings in a free viewing condition of visuo-spatial encoding show decreased fixation probability, saccadic amplitude and reduced saccadic RT.

Now, which pattern will we see in a task where both, verbal and spatial, features have to be encoded? We conducted an experiment using a ring on which pairs of letters, bigrams, were successively shown at different positions. Participants' task was to serially recall these bigrams (verbal task), their corresponding locations (spatial task), or both features (combined task), each in order of presentation. In the single tasks eye movement strategies for verbal and spatial encoding were significantly different. In the combined task subjects adopted the verbal strategy and even though spatial recall performance dropped, its precision remained and only the confusion rate increased. Our findings indicate an obstructive role of direct fixations in spatial tasks as this decreases serial information for locations. In a second experiment we further examined eye movement strategies in combined tasks, comparing bigrams or coloured dots on different locations. Eye movement strategies differed again for the encoding of identity (colour or bigram) and location, but also between encoding of colour and identity. Results indicate that eye movements are highly specific for memory encoding and depend on material as well as task.

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### Age-Related Differences in Consolidation of Implicit Sequence Knowledge across Human Life Span.

KAROLINA JANACSEK, *Hungarian Academy of Sciences/Eötvös Loránd University*, DÓRA JUHÁSZ, *University of Szeged*, DEZSO NEMETH, *Hungarian Academy of Sciences/Eötvös Loránd University*.

Recognizing sequential regularities of the environment underlies motor, cognitive and social skill acquisition, and is essential for predictive behavior and decision making in day-to-day activities. Therefore it is crucial to understand how sequence learning occurs and how the acquired information consolidates and stabilizes over time. The ontogenetic changes of these processes, however, are still poorly understood. Here we aimed to characterize age-related differences in the consolidation of sequential memories between 7 and 85 years of age. Participants were clustered into nine age groups. The Alternating Serial Reaction Time (ASRT) task was used to measure implicit sequence learning. Participants were retested 24 hours after the learning phase. Two aspects of learning were analyzed, namely general skill and sequence-specific learning. We found greater variability in the consolidation of both general skill and sequence-specific knowledge after the 24-hr delay period in childhood between 7 and 13 years of age and in the elderly population (60–85 years of age). These results remained stable even after controlling for age-related differences in overall accuracy and reaction time. Our findings suggest that the fronto-striatal circuits mediating sequential memory formation and consolidation undergo marked changes in childhood and in late adulthood, while seem to be well-established in adolescence and adulthood.

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### Relating the Content and Confidence of Judgments of Learning.

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Some of the key questions in research on memory monitoring concern (i) the type of information available when we evaluate our memory, (ii) the degree to which we are aware of the processes that guide such evaluations and (iii) the number of levels such processes involve. A common method of assessing metamemory is through judgments of learning (JOLs); participants predict their ability to remember recently learned cue-target pairs on a future memory test using either a confidence scale or a yes/no response. Across two experiments (combined  $n = 130$ ), each focusing on either JOL response method, we used a novel paradigm in which participants were asked to give written justifications on a subset of their JOLs (at least 100 justifications were collected per response option). We evaluated the content of these reports using natural language processing techniques (e.g. support vector machine analysis) to quantitatively explore the extent to which and how different response options differ from each other. The results showed that participants are aware of the type of information that influences their JOLs and, as suggested by previous research, primarily focus on cue and target access as sources of evidence for their JOLs. The results further support the idea that JOL confidence is based on a two-level process. This has a direct bearing on contemporary theories of memory awareness and monitoring.

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### Ready, Set, Recall! Revisiting the Memory Benefits of Expecting a Recall Test.

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Recall-expecting learners typically outperform recognition-expecting learners on memory tests. Recall depends on both item-specific and inter-item-relational processing (cf. Hunt & Einstein, 1981). There is evidence that participants expecting recall engage more item-specific elaboration (e.g., Neely & Balota, 1980) and more relational processing (e.g., Smith, 1988), but it is unclear whether both increase simultaneously and whether retrieval processes are also affected. Further, recall is more context-dependent than recognition but recall-expectancy effects on context processing remain unexplored. The current study applied multinomial modeling to disentangle (a) item-specific from relational processing and storage from retrieval processes in free recall, and (b) word from context (source) memory in recognition. Eighty undergraduates were randomly assigned to expect (and practice) free recall or recognition; half of each expectancy-group was then tested with either format. Some study words were semantic pairs (e.g., rose & tulip), others were singletons; words appeared on the screen's top or bottom. Recall-expecting participants outperformed recognition-expecting participants on both formats. Modeling of the free-recall data revealed that recall-expecting participants were both more likely to remember singletons (i.e., item-specific processing) and to encode pairs (i.e., relational processing) with no differences in retrieval processes. Additionally, modeling of the recognition data revealed that recall-expecting participants were not only better at recognizing words but also at remembering the study-position. This





is converging evidence that recall-expectancy increases encoding of various aspects of the item(s). Email: Beatrice G. Kuhlmann, [kuhlmann@psychologie.uni-mannheim.de](mailto:kuhlmann@psychologie.uni-mannheim.de)

(80)

### **The Differential Role of Working Memory and Inhibitory Control in Executive Control Training and Transfer: A Randomised Controlled Trial in Young Healthy Adults.**

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Cognitive training programs usually focus on working memory (WM), and previous studies have shown that WM training may lead to improvements in cognitive functions such as reasoning, intelligence or executive control. On the basis of previous neurocognitive research indicating that inhibitory control (IC) mechanisms also play an important role in higher-order cognition, we aimed to compare the cognitive effects of a training program focused on WM and a training program centred on IC. Healthy young adults from the University of Granada were randomly assigned to one of the two training conditions. Participants were trained across 6 sessions with 3 different computer-based activities of the Cognitive Training Program PEC-UGR (20 min/activity/session). WM training involved maintenance, updating and memory search, while IC training required response inhibition, executive attention and speed processing. Both groups were evaluated with pre- and post-test measures of WM, IC (near transfer), reasoning and proactive interference control (far transfer). Preliminary data suggest cross- interactions between trained and evaluated processes, with each training group showing greater improvements in the respectively trained functions. Despite this differential role regarding near transfer, both groups exhibit an improvement in reasoning measures. These results are discussed in relation to a broader scope of executive control training that would include not only WM but also IC processes, while emphasising the importance of considering individual differences on training improvement.

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### **Adapting to the Retrieval Requirements: When Testing Word Location Hinders Semantic Activation.**

PEDRO MARQUES, LEONEL GARCIA-MARQUES, *University of Lisbon*.

Testing our memories with a specific requisite, or test structure, has been shown to guide (qualitatively) further encoding in subsequent study episodes of new but similar information. On two experiments, participants played a modified version of the Concentration (Pairs) game, studying word pairs (same-category members) behind the cards, but being tested either with a semantic requisite or a location requisite over four study-test cycles. While for the 'semantic' participants a meaning-based relational type of encoding favored their performance, for the 'location' participants a more perceptual-based and shallow encoding was the strategy that benefited the most their performance. When, on a final test, the requisites switch after the study phase (Experiment 1; N=88), the strategies that helped their performance now are shown to hinder it. Also, when asked to verbally generate free-associates to words that were just tested and new words (Experiment 2; N=68), participants in the semantic condition show a clear benefit of the word's episodic status on response time, with faster responses to old vs. new words.

To participants in the location condition, the response time to old and new words is the same, suggesting that the previous repeated testing with a location requisite guided their encoding strategies towards surface characteristics of the items and their relative positions, lowering their semantic activation. This results point at how test structure by itself can promote adaptation in ways that maximize performance in subsequent study-test episodes, given a specific relationship between studied items and test structure, to which learners are sensitive.

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### **Effects of Positive and Negative Mood on Verbal Short-Term Memory.**

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The aim of the study was to examine the influence of positive and negative mood on verbal short-term memory (STM). Mood was induced through the recollection of a specific autobiographic memory. First, participants evaluated their emotional state using the SAM valence scale (Self Assessment Manikin, Lang, 1980). SAM valence scale is a 9-point scale ranging from a smiling, happy figure to a frowning, unhappy figure. The recollection stage then followed: participants were instructed to think to a positive (i.e., an event during which he felt happy), a negative (i.e., an event during which he felt angry) or a neutral (i.e., the route he takes to go to the University) episode of their live and then to write it down. In order to verify if specific mood had been correctly induced, the participants were then asked to reevaluate their emotional state using SAM. The final stage consisted in a STM task where participants attempted to verbally recall lists of neutral words in order. The recollection of autobiographical memories was effective to induce either positive or negative mood. While positive mood had no effect on STM, negative mood facilitated performance. This effect was due to participants making less order errors (i.e., recalling the correct word in a wrong position) in the negative condition. These results were consistent with the 'mood as information' framework (Schwarz & Clore, 2007) which suggest that while positive mood supports a holistic processing mode, negative mood results in more focused processing as required in STM tasks.

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### **One-Year Retention of Implicit Probabilistic Sequence Learning.**

DEZSO NEMETH, *Hungarian Academy of Sciences/Eötvös Loránd University*, ANDREA KÓBOR, *Hungarian Academy of Sciences*, ÁDÁM TAKÁCS, *Eötvös Loránd University*, KAROLINA JANACSEK, *Hungarian Academy of Sciences/Eötvös Loránd University*. Probabilistic sequence learning (PSL) underlies the efficient processing of statistical patterns in our environment and it is therefore crucial in many day-to-day activities. However, only limited information is available about how PSL contributes to long-term memory formation. The aim of the present study was to investigate whether PSL is resistant to forgetting and to retroactive interference over a longer stretch of time. Healthy young adults (N = 29) performed the Alternating Serial Reaction Time (ASRT) task, which separately measures the sequence-specific and general skill learning component of PSL. Three sessions were administered in

the experiment: a learning phase, a testing phase after 24 hours, and a retesting phase after one year. We found evidence for retained PSL and resistance to interference after 24-hour delay. Moreover, results showed retention of sequence-specific knowledge even after the one-year period, indicated by similar performance during the testing and retesting phases. Resistance to interference was also similar in both phases. In contrast, general skills partially decreased after one year. In sum, these results highlight the long-term persistence of sequential memories even without further practice, which could be a key mechanism in understanding the computational underpinnings of long-term memory.  
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### Forget About It: Some Things Are Better Left in the Past. SIMON NØRBY, *Aarhus University*.

Is normal forgetting largely a positive force in everyday life? Although memory loss is often associated with frustration, it does not have exclusively negative consequences, and I suggest that forgetting serves at least three beneficial and necessary functions. First, it is part of emotion regulation, and facilitates subjective well-being by limiting access to negative memories and by dampening unpleasant affect. Forgetting thereby allows for positivity and painlessness. Second, it is involved in knowledge acquisition, and provides a basis for obtaining semantic and procedural knowledge by allowing for abstraction and automatization. Third, forgetting is part of context attunement, and orients information-processing for the present and the future by facilitating environmental sensitivity, and by ensuring that knowledge is current, enabling timeliness and updating. In sum, I suggest that forgetting helps people to be emotionally balanced, cognitively well-organized, and contextually sensitized, and thereby that it serves basically adaptive functions.  
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### Theory of Mind, Memory, and Suggestibility in Preschoolers.

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We examined relationships among *theory of mind* (ToM), *memory*, and *suggestibility*. In the first interview, 94 preschoolers (3-6 y-o) interacted with an interviewer and were administered the Wellman and Liu's ToM scale (Wellman & Liu, 2004) and the Spanish adaptation (see, Diges, Moreno, & Pérez-Mata, 2010) of the Book Suggestibility Scale for Children (BBSC; Melinder, Scullin, Gunnerød, & Nyborg, 2005). A week later, in the Session 2, another interviewer asked children recall and recognition questions (memory measures) about activities performed in Session 1; and children were also tested for their acceptance of misleading information about those activities. Results indicated that ToM was a modest predictor of some memory measures, while acceptance of misleading information was significant related to scores on the BBSC. In contrast with some positions arguing that there is a theoretical relation between ToM and memory (e.g., Perner, 2000), our findings are not a strong support for that, while we have used a scale of ToM with 6 tasks to try to establish that relationship. However, our results highlight the close relationship between a general vulnerability to suggestibility as an individual characteristic

scored by the BBSC and the acceptance of suggestion for an event experienced; that is, preschoolers with higher scores in the BBSC were more likely to accept a false suggestion about something that they did not do the last week with the first interviewer.

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### Selective Directed Forgetting Remains a Puzzle.

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Instruction to forget a list of items leads to reduced memory for those items, indicating that people are capable of forgetting on demand (see Sahakyan, Delaney, Foster, & Abushanab, 2013, for a review). The current investigation concerns whether it is possible to forget selectively—a portion of a list, as opposed to the entire list. Prior research using sentences revealed inconsistent findings, and the current experiments explored selective directed forgetting (SDF) using word stimuli, with a broader aim of investigating the underlying mechanisms behind SDF. In Experiment 1, List 1 words were presented in two different colors. Participants were asked to forget only the words presented in one of those colors (SDF condition), or to forget all List 1 words (standard DF condition), or to remember all of them. List 2 items were presented in the same color as the to-be-remembered items in List 1. The results revealed a standard DF effect, but no SDF. Experiment 2 was identical to Experiment 1 except that List 1 items included word-pairs, with first word of the pair always referring to color (e.g. "RED – garden"), and participants were told to encode the color along with an item. List 2 words were presented in a new color that was not used in List 1. We failed to obtain SDF effect despite encoding of the color. The results are discussed in terms of the strategies people use to selectively forget a subset of previously presented information, as well as individual differences in working memory capacity.

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### The Positive Influence of Elementary School English-Language Activities on Attentional Abilities and Automatization of English Stroop and Reverse-Stroop Effects: A two-year cross-sequential study.

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Even though teaching English language to fifth- and sixth-grade elementary school students, not as a subject but just as an activity to familiarize them with easy spoken English, became compulsory in Japan in the 2011 academic year, there are few researches on the influence these lessons have on working memory. Based on a one-year interval between the first- and second-years of this research project, the study investigated the influence on attentional abilities and selective attentional abilities (automatization), and language processing of fifth- to eighth-grade children (N = 394) who participated in elementary school foreign language (English) activities in Japan by using five easy color-related words, comparing the children's first language (Japanese) and foreign language (English) versions of Stroop (ST) and Reverse-Stroop (R-ST) tests. The principal findings were as follows. First, attentional abilities for both languages increased proportionately with all school grades. Second, regarding automatization (selective attentional abilities as ST and R-ST effects), we found different influences depending on school grades and tests (ST and R-ST tests). R-ST effects (conversion from language label to meaning) of



both languages were only found in the sixth-grade students of the first research project, while ST effects (conversion from meaning to language label) of both languages were only found in the fifth-grade students of the first research project. These results indicate that English comprehension becomes automated at the micro level, proportionate with greater exposure to the language. However, automatization occurs less for the foreign language (English) than for the first language (Japanese).

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### **Visual Memory Can Be Changed By Auditory Input.**

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When trying to encode visual information into memory (for example, the location of a parked car), people often receive auditory input at the same time (for example, the sound of the car doors being locked). Is visual memory affected by auditory input? Existing evidence for cross-modal interactions in other cognitive domains, such as perception and attention, suggests that such interactions may also occur in memory. Here, we tested the hypothesis that auditory input can improve visual-spatial memory. Participants encoded a series of images presented in various spatial locations on the screen (for example, a picture of a dog in the top left corner of the screen) while they heard task-irrelevant, spatially-uninformative sounds (for example, a barking sound played to both ears through headphones) - some of these sounds matched the visual image while others mismatched it. In a subsequent memory test, participants were better at remembering the locations of images that were encoded with a matching sound, even though these sounds were spatially-uninformative. Because the sounds themselves provided no location information, better memory for the locations of images cannot be attributed to better auditory memory. Instead, the results must be attributed to better visual memory due to hearing the matching sounds. This finding provides the first evidence that input in one sensory modality can change memory in another modality, and carries implications for our understanding of how memory works in real-world, multi-sensory situations as well as implications for improving memory in educational programs, cognitive rehabilitation therapies, and human factors designs.

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### **Self-regulated Category Learning: Category Similarity Affects Study Sequencing Choices.**

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Prior research has found that when given the opportunity to select what category to view on each trial, subjects tend to select the same category repeatedly (blocked presentation, Tauber et al., 2012), even though interleaved presentation (exemplars from the same category are never presented consecutively) has been shown to benefit category learning (Kang & Pashler, 2012). We investigated whether subjects' study choices were sensitive to category similarity and whether such choices predicted learning outcomes. In the main experiment, category similarity (high vs. low) was manipulated between-subjects, and subjects selected the category they wanted

to view on each study trial. Subjects studied 48 examples each from 4 categories, and after a short distractor, they were given a classification test that included 16 exemplars (half studied/novel) from each category. On average the high-similarity group made more switches (change in category selection from one trial to the next) and had fewer blocks (selecting the same category for >3 consecutive trials) than the low-similarity group during study. The number of blocks was positively correlated with test performance in the low-similarity group while the average length of blocks was negatively correlated with performance in the high similarity group. Our study provides further evidence for the moderating role of category similarity in the interleaving effect (Calvalho & Goldstone, 2014) and indicates that subjects are sensitive to category similarity when selecting study choices.

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### **The Length of the Within- and Between-Session Breaks Differentially Affects Decline in Reaction Time Performance in a Visuo-Perceptual Learning Task.**

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Decline in performance over a period of continuous training (referred to as reactive inhibition) can greatly confound analysis and distort conclusions of learning experiments. The goal of our study was to develop a method for measuring and filtering reactive inhibition in order to establish a more reliable and refined analysis of learning. One hundred eighty subjects participated in our experiment. The Alternating Serial Reaction Time (ASRT) task was used to measure visuo-perceptual learning. In the training phase, a 15-block version of the ASRT task (each block 1 minute long, with 15-20 seconds between-block breaks) was administered three times with a short break between them (3-5 min). Performance was retested after a 24-hour delay period. Reactive inhibition was characterized by two measures: (1) absolute reaction time increase and (2) the rate of change of this increase within a block of trials. The two measures were differently affected by the lengths of break periods. A regression model is proposed to explain the variability in subject responses that are solely related to reactive inhibition rather than to task variables relevant for learning. Our findings suggest that the magnitude of the effects of reactive inhibition calls for an adequate filtering method that can improve analysis of reaction time data.

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### Is Expertise Needed To Benefit From Spacing During Complex Inductive Learning?

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Inductive learning, forming new concepts or categories by looking at exemplars, reflect people's natural learning ability and plays a central role in education. Despite the findings of spacing effects – learning new material more effectively when study sessions are spaced out over a longer time span - during inductive learning tasks, the role and influence of many other educationally relevant factors still remains unknown. To contribute to this unknown field, we studied the relationship between expertise level and spacing effects in inductive learning. We asked participants with and without expertise to study 72 paintings from 12 different artists, half of these paintings were spaced/interleaved and the other half were massed/blocked. During the subsequent test phase the participants were shown 24 new paintings and had to decide if these items were painted by an artist presented during the learning phase, or by an unrelated artist. Observational Experiment 1a showed a larger spacing effect for experts than for novices, while observational Experiment 1b showed no spacing effect for novices at all. When we controlled for level of expertise in Experiment 2, by training half of the selected participants to become more experienced ('experts'), results show that only people with some level of expertise benefit from spacing during inductive learning. The findings from these three experiments are both theoretically and practically relevant.

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### A Room with an Overview: The Effects of Schematic Processing, Mood and Exposure Duration on Memory Accuracy.

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Studies often posit the processing dichotomy of positive vs. negative affect – people in a negative mood tend to process information in a more systematic manner while those in a positive mood tend to adopt a more heuristic, schema-directed processing style. A 3 (mood: negative vs. neutral vs. positive) x 2 (exposure duration: one vs. five minutes) x 2 (schema-consistent vs. schema-inconsistent items) experiment design was employed in a real-life setting, and using an incidental learning paradigm, to test recognition memory for objects in a typical office. A sample of 99 students (aged 18 to 30, 58.6% female) participated in the study. Following the affect-as-information approach, we hypothesized that induced positive mood will lead participants to engage in a more schema-directed processing leading to less accurate memory, while inducing negative mood will lead to a more analytic and detailed processing, leading to higher memory accuracy and fewer memory errors. Results revealed significant effect of duration indicating that participants made more schema-consistent errors when their stay in the office was shorter. Significant interaction of mood and exposure duration suggests that effect of the exposure on memory accuracy applies for people in negative and neutral mood, while people in positive mood tend to maintain schema-directed processing style for longer period of time.

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### The Context Shift Account: Not an Explanation for the Fragility of Interim Test Effect with Text Material.

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Taking interim tests over previously studied information facilitates the learning of subsequent information (Szpunar, McDermott, & Roediger, 2008). However, recent research has established that for text material, the interim test effect is robust on an immediate test but attenuated on a delayed test (see Wissman & Rawson, 2015). One plausible explanation for the fragility of the interim test effect with text is the *context shift account*, which states that engaging in retrieval-based tasks induces an internal context shift that enhances memory on an immediate test by decreasing access to previously learned information and thus reducing interference from that information (Divis & Benjamin, 2014). Learners read an expository text, divided into three sections. Following Section 1 and Section 2, learners either recalled information from the previously studied section (section recall), recalled exemplars from taxonomic categories (semantic recall), or completed Sudoku (control). After Section 3, learners completed an immediate test in which they recalled information from Section 1 or Section 3. After a delay, learners again recalled information from Section 1 or Section 3. On the immediate test, Section 3 recall was greater for the section recall group versus the control group, replicating the interim test effect. Section 1 recall was similar for all three groups, inconsistent with the context shift account. On the delayed test, Section 3 recall was greater for both recall groups versus the control group. Results establish that the context shift account is not a viable explanation for the fragility of the interim test effect for text material.

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### Methodology

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### Adaptation and Validation to Spanish of the Servant Leadership Short Scale.

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Servant leadership focused in the kind of leader that prioritizes the wellbeing of their followers over the objectives of the group. There were several psychometric tools to assess servant leadership, usually comprised of a large number of items. The purpose of this research was to validate a reduced Spanish version of the Servant Leadership Profile (SLP). First, a number of experts evaluated and reduced the original scale to 14 items, named Servant Leadership Short Scale (SLSS). Then, an exploratory factor analysis conducted over 1,001 school students revealed two possible structure solutions (one factor solution and two correlated factors solution). A second study was conducted with a different sample of 456 students to examine the latent structures explored the previous study. A one-factor solution was proposed following an optimal principle between parsimonious and fit ( $\chi^2/df = 3.4$ , CFI = .91, TLI = .90, RMSEA = .07, SRMR = .06). Concurrent validity was assessed in a third study with a new sample of 202 students, demonstrating that





self-efficacy and gender are two good criteria measures. Reliability analysis in the three studies showed that this 14-item Spanish version had high internal consistency. Taken together, the results of the three studies support the application of the SLSS in future research. Email: Manuel Martin-Fernandez, [manuel.martinf@inv.uam.es](mailto:manuel.martinf@inv.uam.es)

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### **The PCL-R: Its Dimensionality, Reliability, and Adjudication, Revisited.**

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There has been no shortage of disharmony, amongst researchers, in respect the issue of the structure of the Psychopathy Check List-Revised (PCL-R), prior studies having yielded, as an estimate of the test's dimensionality, numbers lying within the range two to seven. However, there are good reasons for doubting the relevance of these previous results to an adjudication of the test's performance, chief among them, the fact of their resting on a sense of dimensionality-the linear factor analytic sense- inconsonant with the test's theoretical structure. Herein, we reconsider, afresh, the issue of the performance of the PCL-R, through the undertaking of a test analysis that accords with the principles of modern, sequential, test analysis. Accordingly, we tested the unidimensionality of the PCL-R items under the unidimensional monotonic latent variable model. In a sample of 176 offenders newly admitted to correctional services in British Columbia and the Yukon Territory, results indicated that only one of the off-diagonal elements of the sample covariance matrix was negative; consequently, the hypothesis of associatedness was retained. A graphical and quantitative description of the 190 Mantel-Haenszel statistics computed is presented. The mean of these statistics was .707, 32.1% were negative, and only one resulted in a rejection of its corresponding null hypothesis. We concluded that, in the population under consideration - the PCL-R is, in fact, unidimensional, and, hence, compositable. A lower bound to the reliability of the optimal linear composite is estimated as .75.

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### **Does Chess Training Improve Some Cognitive Abilities in Children? A Meta-Analytic Study.**

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There is a great interest nowadays on the effects of chess training in children's formal education based on its proposed improvement of several cognitive abilities. Due to this interest, several countries are planning to integrate chess training into the school curriculum. However, there is not yet an empirical measure of the beneficial effects of playing chess on school achievements. To assess the median effects of chess training on school achievement and the moderator variables that modulate the effect, we conducted a meta-analytic study with pre-post published intervention studies conducted with children and teenagers. We found 10 original studies that fulfilled all the criteria and we analyzed them with Comprehensive Meta-

analysis program. The results showed that effect is middle in Cohen's term. Moreover, the results showed that chess training can improve some aspects of the scholar skills as reading and mathematical abilities. These results might have educational impact and allow us to ascertain precisely the educational benefits if chess training is included in the formal education. Importantly, the results of the present meta-analysis allow us to compare these benefits with those of others non-chess interventions such as music or computer programming.

### **Sensation and Perception**

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### **Effects of Binaural Beat Stimulation on Sustained Attention in Scholar Children.**

MICHELE CAGOL, DEMIS BASSO, *Free University of Bozen-Bolzano*.

Binaural beats are amplitude-modulated signals occurring when two sine waves with slightly different frequencies are presented separately to either left and right ears. Despite the physical separation of the two sounds, but thanks to the activity of brainstem neurons in the superior olivary nucleus, listeners perceive a rhythmic sound with a beat frequency equal to the difference between the frequencies of the two waves. Binaural beat stimulation within the EEG frequency range seems to be a non-invasive methodology to influence brain activity and to affect states of consciousness, psychomotor performances, and mood. This research is aimed at investigating the effects of binaural beat stimulation (in the EEG low gamma and theta frequency ranges) on performance of a sustained attention task in primary school children. Each participant performed a 10-minutes visual task for three sessions: one involving binaural beats with theta frequency (5 Hz), one with low gamma frequency (40 Hz), and one with no binaural beat stimuli (as control condition). EEG activity was measured for each condition. Results showed that low gamma binaural beat stimulation, compared to theta and control conditions, has improved children's performance in the sustained attention task. Moreover, low gamma band neural activity increased its amplitude, corresponding to the auditory stimulation in this band. This pattern suggests that this technology may represent a non-invasive method to enhance children's attention (i.e.: during homework).

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### **Isolating the Influence of Stimulus Expectancy on Duration Estimation: Evidence from Self-Generated Expectations.**

TERESA BIRNGRUBER, HANNES SCHRÖTER, ROLF ULRICH, *University of Tübingen*. Previous studies have shown that the duration of unlikely stimuli is judged to be longer than the duration of likely stimuli. This effect has been attributed to stimulus expectancy. One drawback of this traditional approach is that it implicitly presupposes that stimulus probability only affects expectation. Here we introduce a novel paradigm that isolates the effect of stimulus expectation on perceived duration. To this end, participants were instructed to vocalize their stimulus expectations on each trial. In a temporal bisection task, blue and yellow disks of varying durations (280 - 920 ms) were presented and the

participants' temporal task was to rate each stimulus as rather short or long. Additionally, participants gave a vocal response prior to each stimulus presentation, indicating the color they expected to appear in the given trial (the colors appeared equally likely and independently from the participants' predictions). To measure perceived duration, separate bisection points were estimated for trials in which the presented stimulus color matched the participant's expectation (expected condition) and trials in which the presented color did not match the expectation (unexpected condition). Since this method of "self-generated expectations" has been shown to be a potent way of capturing expectancy in previous studies, we expected to observe significantly different bisection points in the two conditions if stimulus expectancy per se influences perceived duration. The findings are discussed in the light of previous mixed results regarding the influence of expectancy on duration perception as well as prevailing models of time perception.

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### Processing Dynamics of Intrinsic and Extrinsic Grouping Cues.

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We examined the processing dominance of perceptual grouping cues using a paradigm comparable to that used in the study of processing dominance in hierarchical patterns (D. Navon, 1977). Participants attended to perceptual groups based on different grouping cues in different blocks of trials and were required to indicate their orientation. In each block, single and competing grouping cues were presented under different exposure durations. In Experiment 1, intrinsic vs. intrinsic cues (proximity and shape similarity) were compared using this procedure, whereas extrinsic vs. extrinsic cues (common region and connectedness) were displayed in Experiment 2. The results showed that in Experiment 1, no dominance of any grouping cue was found: shape similarity and proximity grouping cues showed similar reaction times (RTs) and interference effects. In contrast, in Experiment 2, common region dominated processing: (i) RTs to common region were shorter than those to connectedness; and (ii) when they competed, common region interfered connectedness more than vice versa. The results showed that the relative dominance of single grouping cues influenced the processing dominance of competing cues, independently of the exposure duration of stimuli but determined by the perceptual salience of the grouping cues. We also found an important result indicating that when two grouping cues compete, both the non-attended intrinsic cue in Experiment 1 and the non dominant extrinsic cue in Experiment 2 are not completely lost and they are still perceived.

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### Interactions between Grouping Principles in Active Touch: A Behavioral and Brain Oscillations Study.

ANTONIO PRIETO, JULIA MAYAS, SOLEDAD BALLESTEROS, *Universidad Nacional de Educación a Distancia*. Perceptual grouping is not a unitary phenomenon. Different

grouping principles have different processing requirements, time courses and relative salencies. Previous findings in touch suggest that spatial proximity (P) is a more salient grouping principle than texture similarity (S). However, it is unclear whether this greater salience will result in an asymmetrical interaction pattern when both grouping principles act conjoined both in a competitive or cooperative way, as occurs in visual modality. The present study aims to investigate this interaction pattern in the haptic modality using an adapted repetition discrimination task (RDT) that resembles the one devised by Palmer and Beck (2007). In this task, participants are presented with a single row of elements that alternate in texture except for a pair in which the same texture is repeated. The participants' task was to determine whether the repeated textures (similarity grouping) are smooth or rough. A 2 (non-target separation) x 2 (target separation) within-subjects factorial design was used, resulting in four different interaction conditions: S+P (cooperation), SvP (competition) and SP0/SP1 (neutral close/far). Behavioral results indicate that response times and error rates increase when both grouping principles compete. Interestingly, neutral conditions differed, suggesting that non-targets proximity also affects grouping interaction irrespective of how targets are grouped. Moreover, brain oscillation data showed increased and long-lasting frontal and parietal alpha desynchronization in the competition condition relative to the cooperation condition. This pattern of results is in agreement with the higher exploration times and the need to resolve the conflict between both grouping principles.

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### Vertical Representation of Auditory Loudness.

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Little is known about the possible crossmodal association between loudness and verticality. This lack of research contrasts with the extensive use of a direct translation of loudness (e.g., high vs. low sounds) into the vertical plane (low vs. high spatial positions, respectively) in disciplines such as ergonomics, design and sound engineering. We investigated whether the possible association between loudness and spatial elevation can modulate our movements. Participants listened to a reference tone and then to a comparison tone with the same frequency, but different intensities. They were asked to decide, pressing the correct button with a vertical arm movement, whether the comparison tone was more or less intense than the reference tone. Crucially, the two buttons were placed above or below the initial position of the participants' hand. There were two experimental conditions: in the *congruent* condition, participants responded to the more intense tones with the upwards button and to the less intense tones with the downwards button. In the *incongruent* condition, the buttons used for responding to the different intensities were inverted. The arm movement was, therefore, congruent or incongruent in relation to the intensity of the tone. The results revealed a crossmodal correspondence effect between loudness and verticality for both high-upward and low-downward associations. Overall, this pattern of results suggests that the representation of loudness and verticality interact, thus



influencing both upward and downward movements.  
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### Symmetry Features and Group Hierarchy Model Human Symmetry Perception.

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This study investigates human ability to perceive various features of visual symmetry. The literature has focused exclusively on bilateral reflection symmetry, with some suggesting that it is the only type of symmetry humans can perceive (Wilson&Wilkinson, Vis. Res. 42(5), 2002). We seek to demonstrate that humans can recognize every group-theoretic symmetry in wallpapers (Liu, Found.&Trends in Comp.Graph.&Vis., 2008) and examine which features they likely use. We also ask whether subgroup distance, the shortest path in the theoretical group hierarchy from one group to another, may be a better proxy describing human perceptual processes. 106 individuals recruited on Amazon Mechanical Turk participated in an experiment asking for three images (target, probe, probe) to be compared, and to choose the probe most similar to the target. (Ten were removed due to non-compliance.) Each participant performed 272 trials, comparing every one of seventeen groups to every other group. Participants could distinguish among every single wallpaper group. Every group comparison except one) was distinguishable ( $p < 0.05$ ). Logistic linear mixed-effects regression modeling predicting similarity choices resulted in a best model that included distance, 3-fold rotation, 4-fold rotation, and the T1 and D1 axes (according to AIC-based model selection). Even when taking all other features into account, hierarchy distance was a significant additional predictor ( $p < 0.0001$ ). This suggests that the mathematically motivated symmetry group hierarchy may be a valid model of pattern perception.

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### Gender-Science Stereotype Could Bias Our Interaction with Washing Machines.

ROSSANA ACTIS-GROSSO, PAOLA RICCIARDELLI, *University of Milano – Bicocca*. According to the CASA (Computer Are Social Actors) paradigm, individuals apply social cognitive constructs and stereotypes to computers and new media. We investigated whether the CASA paradigm could be applied also to other more basic technological devices (e.g. household electrical appliances, which are becoming increasingly more technologically sophisticated). We hypothesized that humans apply gender-science stereotype to such devices, so that the technological ones would be associated to male and the less technological ones to female. To test this hypothesis, two Implicit Attitude Test (IAT) have been performed. A preliminary IAT tested the presence of gender stereotype in our sample. In the first IAT, participants ( $n=80$ ) have been asked to associate two target concepts (i.e. pictures of traditional washing machines and computers) with an attribute (i.e. a proper name) indicating a male or a female: results show a stronger association of washing machine with female and of computer with male. In the second IAT target concepts were represented by pictures of (a) highly technological washing machines and (b) computers with features typically attributed to female-style. Contrary to previous IAT, results show a stronger association of

washing machines with male and of computers with female. Results are discussed in light of possible effects of this implicit gender stereotype on apparent usability and customer satisfaction.

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### Colour Categorization without Colour Naming.

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Humans group colour, a continuous perceptual attribute, into discrete categories associated with corresponding verbal labels. However, it is debated whether colour naming is necessary for colour categorization. To test this idea, we developed a task that allows for measuring colour categorization without colour naming. Participants saw bi-colour stimuli (e.g., red/green or light blue/dark blue) in groups of three. They were asked to respond as fast as possible to the stimulus containing colours that belonged to different categories (e.g., red/orange) by pressing a corresponding keyboard key. In different sessions, participants performed the experiment either without or with verbal interference (counting aloud). If the task indeed measured categorization independent of verbal labelling, verbal interference should not impair the performance. Preliminary results show that interference even improves colour categorisation by reducing response times, with no measurable influence on accuracy. Thus, our preliminary results suggest that colour categorisation can occur without the involvement of verbal labelling. While verbal labelling might still be an important strategy to learn colour categories, it might become detrimental to fast colour categorisation when the categories are well established, as in the case of healthy adults.

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### Perceptual Bistability in the Visual and Auditory Domain – Effects of Level of Processing and Modality.

MIHAELA TARANU, SUE DENHAM, MARINA C. WIMMER, *Plymouth University*, ISTVÁN WINKLER, *Hungarian Academy of Science, University of Szeged*, DAVID FARKAS, *Hungarian Academy of Science*, RAYMOND VAN EE, *Philips Research Laboratories, University of Leuven, Radboud University Nijmegen*. Spontaneous perceptual switching in visual and auditory perception is considered either domain specific or domain general. Moreover, very few studies take into account that different stimuli give rise to competition between aspects of the alternative interpretations (e.g. form/content or direction of motion) that depends on processing at different levels of the perceptual hierarchy.

We investigated the question of domain generality/specificity in switching patterns in both visual and auditory tasks, with different categories of bistable stimuli: auditory streaming and ambiguous-figure-from-motion (low level feature rivalry), and verbal transformations and duck/rabbit ambiguous figure (high level



content rivalry). Participants' switching patterns were measured in two adults studies for one (N= 81) or two minutes (N = 18) across five blocks. We also examined whether executive functions (inhibitory capacity, set-shifting) and creativity relate to perceptual switching.

We provide behavioural evidence that the level of processing has an influence on the switching rates in both the visual and auditory bistability. Higher level stimuli had higher switching rates than the low level stimuli in both studies. The effects of modality and the interactions were different in the two studies and are discussed in terms of stimuli parameters. The cognitive tasks did not correlate with switching rates. In conclusion, we find that the level of processing has a strong effect on the switching rates both in the auditory and visual bistable stimuli and that stimuli parameters have a large impact on the modality effects.

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*Keywords: bistable stimuli, visual and auditory perception, consciousness*

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### **Impaired Head/Eye Integration, But Intact Head/Body Integration, in Congenital Prosopagnosia.**

KARL VERFAILLIE, FILIP GERMEYS, LEIA VRANCKEN.

Researchers now generally share the consensus that faces are processed holistically. It is difficult to understand the impact of this ability until we encounter someone who is not able to recognize familiar faces at first glance. Prosopagnosia refers to a condition in which a person is unable to visually recognize faces, without any other visual deficits. It has been hypothesized that this impairment in face recognition is due to an underlying lack of holistic face processing. Evidence suggests that bodies, as faces, are also perceived in a holistic manner, and the question emerges if the impairment in holistic face processing in prosopagnosia extends to body perception. Recently, we designed an identity-independent composite design for face- and whole body stimuli. In the current experiment, we compared performance on this task in participants with congenital prosopagnosia (CP) with performance in a matched control group. Results provide evidence for an aberrant head/eye integration in CP, but not for head/body.

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### **On Colour and Category Effects: Longitudinal Evidence in Alzheimer's disease.**

INMACULADA C. RODRÍGUEZ-ROJO, *Universidad Complutense de Madrid*, JORGE LUGO MARÍN, *Hospital Universitario Nuestra Señora de la Candelaria*, F. JAVIER MORENO-MARTÍNEZ, *U.N.E.D.*

The role of colour in object recognition is controversial, both in normal controls (NC) and in patients with Alzheimer's disease (AD). I in this study, a critical review of previous studies, as well as a longitudinal study, was conducted. We examined whether colour benefits the ability of AD patients and NC when naming items differing in colour diagnosticity: Living Things (LT) vs. Nonliving Things (NLT). Eleven AD patients were evaluated twice with a temporal interval of 3 years; 26 NC were tested once. The participants performed a naming task (colour and greyscale photographs); the impact of nuisance variables (NVs) and potential ceiling effects (which influenced previous works) were also controlled. Our results showed that: (i) colour slightly favoured

processing of items with higher colour diagnosticity (i.e., LT) in both groups; (ii) AD patients used colour information similarly to NC, retaining this ability over time; (iii) NVs played a significant role as naming predictors in all the participants, relegating domain to a minor plane; (iv) category effects (better processing of NLT) were present in both groups. Finally, although patients underwent semantic longitudinal impairment, this was independent of colour deterioration. This finding provides better support to the view that colour is effective at the visual rather than at the semantic level of object processing.

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## **Special Session**

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### **Why Do Drivers Miss Hazards? The influence of Type of Obstacle, Road Complexity and Physiognomy of the Road Section on Hazard Prediction.**

A. GUGLIOTTA, *University of Granada*, P. VENTSISLAVOVA, *Nottingham Trent University*, E. PEÑA-SUÁREZ, P. GARCIA-FERNANDEZ, E. EISMAN, *University of Granada*, CRUNDALL D. *Nottingham Trent University*, CASTRO C., *University of Granada*.

To avoid accidents when driving, the ability to detect, evaluate and react to hazards is essential. Some of the mistakes drivers make when detecting hazards could be explained by their proneness to distraction, but the role played by different variables in increasing distraction should also be considered. This study aims to analyse how variables related to the type of obstacle: Vulnerable Road Users (VRUs: pedestrians, cyclists and motorcyclists) vs. Vehicles (cars and lorries), the Complexity of the Road (crowded urban streets vs. interurban roads) and the Physiognomy of the Road Section (intersection or straight) contribute to drivers' distraction when performing the driving task. The recent Spanish Driving Hazard Prediction Test was used to measure drivers' performance in Situation Awareness (S.A). The sample comprised 143 participants, 48 female and 94 male. Three groups of drivers were recruited: learner, novice and experienced. Drivers' SA was higher when vehicles were the obstacles presented and lower when vulnerable users were the obstacles shown. Drivers' SA was higher when the hazards appeared on interurban roads than when they occurred on crowded urban roads. Scene context interferes with the perception of objects when scene complexity is high. However, driver's SA was also higher at the intersections than on the straight roads. Drivers' SA of expected objects appears to improve when the driving environment seems to be riskier. Finally, the main effect of driving experience was found to be significant. Experienced drivers' SA was higher than Novice drivers' SA and Learner drivers' SA.

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## ABSTRACT BOOK

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